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Earth Sciences for Society

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Home planet

It is only one
but it is our one.

One grain, small
in the empty, endless sands
of space and time.

From the dust
and the debris
of cosmic collisions,
the planet grew,
and bore life.

Cooled to blue,
The heat of its heart
recycling continents
reshaping landscapes
driving the dynamic of diversity.

From infinite habitats
came infinite patterns for life
One came who could see
the wonders of its home.

Nothing is here
to benefit man,
But man can benefit
from all that is here.

Just marvel;
And handle with care

By David Kirk

ENVIRONMENT AND HERITAGE SERVICE

GSI

Department of Enterprise, Trade and Investment

Geological Survey of Northern Ireland

Earth Science 2000 – *raising awareness of Earth science across Ireland*

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EDITORIAL

International Year of Planet Earth is here! Proclaimed by the UN General Assembly to raise global awareness, and demonstrate the role Earth Scientists play in ensuring a safer, healthier and wealthier society.

So much is happening this year that we cannot cover it all in this magazine. Sorry! Lists of events are important but don't make exciting reading. So I urge you to look up events on the various websites, mark the ones of interest in your diary and join in.

The Geological Survey of Ireland in spearheading the Irish effort and already it 'feels' as though the earth is starting to spin faster. Try it's website www.planetearth.ie and www.bgs.ac.uk/gsni/iype, www.habitas.org.uk/es2k, www.ehsni.gov.uk .

ES2k has the same aim as the UN, raising awareness of Earth Science but of course in Ireland. All the contributors to this issue are playing their part, as are many others by appearing on TV, radio, leading walks and giving talks. Thanks to them all. It will make a difference!

Contributions, please, for the next issue to the Editor or the Provincial Correspondents – for **Connaught** Martin Feely, Department of Earth & Ocean Sciences, NUI Galway martin.feely@nuigalway.ie - for **Leinster** Matthew Parkes, National Museum of Ireland, Merrion Street, Dublin 2 mparkes@museum.ie - for **Munster** Bettie Higgs, Department of Geology, NUI Cork b.higgs@ucc.ie - for **Ulster** Alistair Ruffell, School of Geography, The Queen's University of Belfast, Belfast BT7 1NN a.ruffell@qub.ac.uk.

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■ Tony Bazley, Editor, Earth Science Ireland,
19 Inishanier, Killinchy, Newtownards, Co Down BT23 6SU
Email: rbazley@btinternet.com

DRILLING FOR OIL AND GAS

Exploration drilling is likely to restart in Northern Ireland shortly. Mancon Energy Inc, a Canadian operating company, will probably have a large drill rig positioned somewhere in north Antrim by the time you read this note.

It is some years since deep drilling for hydrocarbons was carried out in Antrim. The fact interest is being expressed again – and drilling is a serious expression of interest because it is a costly operation – suggests the prospects of finding economic resources are considered reasonable. The work will not have started without detailed new analyses of past and new data, maybe some from the Tellus Project.

We look forward to reporting more detail in the next issue of this magazine.

Congratulations to Kirstin and Andrew Thompson on the birth of Adam James Thompson 6lb 0oz born on the 16th February.

Kirstin is, of course, otherwise known as Dr Kirstin Lemon, Secretary of ES2k. What can more can we say? Except for a *Geo*park *Geo*logist *Geo*rge was the name the bets were on – Adam's good.

Cover:

Globe by John Dooley, GSI.

Poem by David Kirk

Now in Business - International Year of Planet Earth

L to r: Prof Ed de Mulder, International Coordinator IYPE; Prof Aubrey Manning, guest speaker; Minister Ryan; Dr Peadar McArdle, Director GSI

Dublin Castle on 18th January was the venue of the official opening.

Minister for Communications, Energy and Natural Resources Eamon Ryan TD officially launched Ireland's Programme for the 60th United Nations General Assembly's "2008 - International Year of Planet Earth (IYPE)", an international initiative which aims to raise awareness of the earth sciences.

Ireland's programme of events entails a series of countrywide events throughout 2008, which will be coordinated by the Geological Survey of Ireland (GSI) and a number of partners including, for example, the Royal Irish Academy.

Minister Ryan stated, "*The IYPE is an international response to the concerns of earth scientists that their knowledge of the earth is a valuable resource that is underused and underestimated. Geoscience is essential as we attempt to address the numerous environmental and sustainability challenges that threaten the planet as a result of ongoing human activities.*

The common role of geoscience relates to the exploitation of natural resources. Yet, it also has huge potential to influence environmental issues, as it provides us with detailed information about the workings of our planet.

There is no better time than now to focus on this. Extreme weather events are becoming more common. We are aware that we must use our earth's resources in a responsible, sustainable manner. Climate change is a global emergency to which we must respond.

But we cannot respond unless we are informed. We cannot take action unless we listen to our scientists. The message is clear – urgent action is needed to protect and preserve our planet.

Themes to be promoted throughout the year include climate change, maritime issues, natural resources, groundwater, environmental hazards and deep earth structures. These will be discussed in detail in a series of "Planet Earth" public lectures that started on this day with a lecture by Professor Aubrey Manning.

The Opening Ceremony

Further details on all events can be found at www.planetearth.ie We urge people to watch out for what's on and join in.

From The ES2k Chairman – **Paul Lyle**

The Giant's Causeway

A recurring theme within ES2K over the last few years has been the Giant's Causeway and its problems. Now it has become something of a political football – when was the last time geology was involved with ministerial resignations? The eagerly awaited return of devolved government, far from expediting the building of a world-class Visitors' Centre has put the whole situation back in the melting pot. The squabble, with money being the root of it all, has been unseemly to say the least. UNESCO has become involved in this debate and it threatens the World Heritage status of the site. The Earth science community in Ireland has every reason to be seriously concerned.

In a previous edition of this magazine, the editor Tony Bazley queried whether those responsible for the administration of the Causeway fully realise the importance of World Heritage status. The site has played a key role in the development of scientific thought since the late 18th century. Now, with the country getting back to 'normal' business, thousands of geologists from all over the world are travelling to Ireland to see it. A 'must-see' geological experience that is on a par with the Grand Canyon or Yellowstone Park!

The geological community thought, naively, that the design for a world-class Visitor Centre had been settled by a prestigious international competition. My hope is that reports are true that the local council and the National Trust, facilitated by the Environment & Heritage Service, are at last getting together to quickly find a way forward. Visitors to the Causeway deserve much better facilities than are now supplied.

As an expert I find the continued closure of the Lower Cliff Path at the Causeway a further frustration. The world famous geologist, S.I. Tomkeieff, in his classic publication of 1940, compared the Giant's Causeway to the row of columns, the ***colonnade***, which supported the roof of a classical Greek temple. He likened the thinner, curved columns at the top of the flow to the carving or ***entablature*** that sat above the colonnade. These terms are now used all over the world. The Causeway coast is the "type locality" for what are known as "multi-tiered columnar basalts" but currently the only way to see them fully is from a boat moored offshore. The apparent lack of urgency to do anything positive about re-opening the path is to be deplored. It reflects the limited geological input into the management decisions for the most important geological coastal section in Ireland.

Just when we think that things cannot possibly get worse, along comes news that there is an active lobby putting forward a creationist view of the origin of the Causeway lavas – and wanting equal status with the scientific explanation in any future Visitors' centre. Elsewhere in this issue you will read what we think about this!

Given these problems the consequences for the Causeway of global-warming and associated sea-level rises can be put on the back burner. If sea level rises sufficiently to affect the Causeway, then flooding problems elsewhere in Ireland will be causing much more anxiety.

European Ministers, at the launch of International Year of Planet Earth, called for scientists to explain to the global community the challenges they must take up. They stressed the importance of giving scientists a greater role so as to allow informed decisions. Europe does this by consulting experts as much as possible when framing public policy. Geologists, geophysicists and geochemists studying the earth and the upheavals that have occurred during its history for over four billion years must clearly play a central role. ES2k is voicing this wish in relation to the Giant's Causeway…but is anybody listening?

WINNING STUDENTS

Irish IYPE Winners go to Paris

An international competition co-ordinated by UNESCO was held to choose 250 students from around the world to attend a major conference being held in Paris in mid - February. The conference was considering geoscience issues of critical importance to the future well-being of our planet *and* it marked the official launch of IYPE.

Here, the IYPE National Committee, chaired by the Geological Survey of Ireland, invited students from third-level colleges across the island to enter their essays, poems and paintings on suggested themes. An expert panel selected three winners:

First Prize was awarded to **Claire Jane Taylor**, Queen's University of Belfast, for an essay "*Reading Earth as Palimpsest*".

Emma Helbert, NUI Galway, won Second Prize for a painting entitled "*Symphony of the Sky*"

Third Prize went to **Nikita White**, University College Dublin, for her essay "*The inspirational Penguin*"

All represented Ireland at the Paris conference and will have had a chance to see internationally renowned scientists, industrial chiefs and political leaders in action; maybe even meet some of them. It should have been an inspirational opportunity. Was it? I will try to get some feedback from the students before the next issue.

Mr Eamonn Ryan TD, Minister for Communications, Energy and Natural Resources, congratulated the winners before they set off for Paris in 'nearly' springtime. He emphasised the importance of geoscience issues in all our lives. Ireland has a history of involvement in mineral and energy resources and now the challenge is to limit damage to our climate by investigating the potential for underground storage of carbon dioxide produced by burning fossil fuels. Another key issue is the provision of clean water supplies. Ireland relies for 25% of its water on groundwater sources and these need to be protected from pollution. He mentioned the €9.2 million awarded last year to research teams around Ireland to address such issues, including those that might be made more problematic by climate change. This tranche of money, the Griffith Geoscience Research Awards, is undoubtedly giving a huge boost to research in Ireland.

Editor

LEITRIM BEARS GIVE UP THEIR SECRETS

If you go down to the woods today you will not find any bears - but visit the National Museum of Ireland's store at Beggars Bush in Dublin and there they are. *Plus all sorts of amazing remains*. You need, of course, a special reason for going 'behind the scenes' but last autumn Nigel Monaghan, Keeper of Natural History at the National Museum of Ireland, kindly took several of us around.

The store is a real treasure trove of items collected over the past centuries. Skulls, antlers, horns and bones of almost everything you can think of. Much of the material comes from Ireland but there are also unique collections made by adventurous Irish people travelling abroad. Good work is being done to prepare the material, make it more accessible for future researchers and, in some cases, getting it ready for new public displays.

Bears lived alongside people until between 1,000 and 2,000BC

It was seeing the remains of a bear that reminded me of a talk by Nigel Monaghan in Cork about 18 months ago. Our wild bears are long gone. ***Although not so long gone as first thought***. In fact they lived alongside people in Ireland for around 6,000 years.

Brown Bear Photo courtesy of John Nickles

It has been established, by radio carbon dating techniques, that the bear remains in Leitrim, found in a cave in the Glenade valley, are between 3 - 4,000 years old. They probably used the cave as a winter den between 1,000 BC to 2,000BC. If you want to see the bones visit the Marble Arch caves in the Fermanagh Geopark Centre – they are displayed in a case just inside the visitor centre main entrance.

The bears are of the ferocious brown bear (*Ursos arctos*) variety, the male of which weighs about 360kg. They lived in Ireland at a time when it was covered with dense elm, hazel and pine forests. The influence of people in clearing land for agriculture and draining boggy ground had not started. It was probably these activities, which changed the face of our landscape, that eventually lead to the bears' demise, along with lynx and wolves!

Dating of bear bones in Ireland has shown they also lived here over 35,000 years ago, well before the maximum extent of the ice of the last glaciation. The question to be answered is whether they survived in Ireland during that intensely cold period, hanging on in the unglaciated part of the extreme south of the country. That bit of southern Munster would have been pretty inhospitable. Perhaps more likely is that they retreated far south when the bitter cold struck and the ice advanced, returning via land bridges at about the same time as people arrived around 8,000BC.

The record in Ireland is incomplete and, apart from bears, it raises the question of whether people actually came at a much earlier date than can be proved. If Boxgrove and Swanscombe people were living in southern Britain (from around 400,000 years ago) it is surely almost inconceivable that they didn't venture to Ireland when the land was joined and other mammals were coming across. The ice just did too efficient a job in sweeping away the evidence?

Brown bear Photo courtesy of Karen Laubenstein

DNA studies show value of 19th century collections

Ceiridwen Edwards, a DNA expert at the Smurfit Institute of Genetics, Trinity College, Dublin, is studying the DNA of 17 bears from all over Ireland and might be able to say if one bear population survived here or whether populations have come and gone. Interesting work! She has confirmed by DNA testing that the Giant Irish Elk is really a Giant Irish Deer. We will try to contact her before the next issue to see if the work on bears is completed. It shows one aspect of the value of museum collections. The Natural History museum started its collection of bear bones in the 19th century. William Wilde, father of Oscar, was the curator in 1852 when a bear skull found during drainage work near the Boyne River was delivered. These, and many other, old bones are being dusted off for analysis and the results might change our view of Ireland's pre-history. ***Tony Bazley***

BRONZE AGE GOLD IN IRELAND

Norman Moles (University of Brighton) reports on work to rediscover the source:

I have been collaborating with the Geological Survey of Northern Ireland in the evaluation of new prospective precious metal occurrences revealed during the recently completed Tellus Project. Stream sediment and soil geochemistry data from the Tellus Project showed gold anomalies in areas of Lower Palaeozoic bedrock. The research is being undertaken with ***Rob Chapman, University of Leeds***, and involves follow-up sampling at the most promising sites in South Armagh and in the Mourne Mountains of County Down. Large amounts of stream sediment have been sluiced and panned to recover heavy mineral concentrates from which sand-sized particles of natural gold were recovered. We have used the technique of micro-chemical characterisation, in which sets of gold grains are defined both in terms of the alloy compositions (mainly silver and copper, with platinum group elements at some sites) and the mineralogy of tiny inclusions within the grains.

Rob & Norman sluicing stream sediment in the Mourne Mountains (Photo: Richard Warner)

Early Bronze Age lunula from Rossmore Park, Co. Monaghan (Photo: Richard Warner)

Mourne Mountain gold?

Previous studies have identified gold sourced from the Lower Palaeozoic rocks in Counties Down, Armagh and Monaghan as the best match in terms of silver content to that used to fabricate Irish gold artefacts in the Early and Mid Bronze Ages. However the copper content of these artefacts is consistently higher than that of most alluvial gold in the region. We have found that newly discovered (or re-discovered?) gold from the western Mournes is copper-bearing and is an excellent match with artefact gold compositions, according to archaeologist Richard Warner (formerly of the Ulster Museum). This suggests that sources in the Mournes area may have been exploited in antiquity. Ongoing work seeks to find localities where this gold occurs in sufficient quantity to have been exploited in the Bronze Age - and could possibly be mined today. This is a major challenge as the Mournes is an area of outstanding natural beauty!

(Norman was a lecturer in geology at Queen's University until the department closed and is a Past Chairman of ES2k - Editor)

ANNUAL SHINDIG STILL GOING STRONG

Question: Where, these days, do you have a conference that is free of charge, mixes university research students with staff on an equal footing and has an eclectic range of Earth science topics *not* run in parallel sessions? Also, many students presenting, for the first time, their research results to an audience of their peers and mentors?

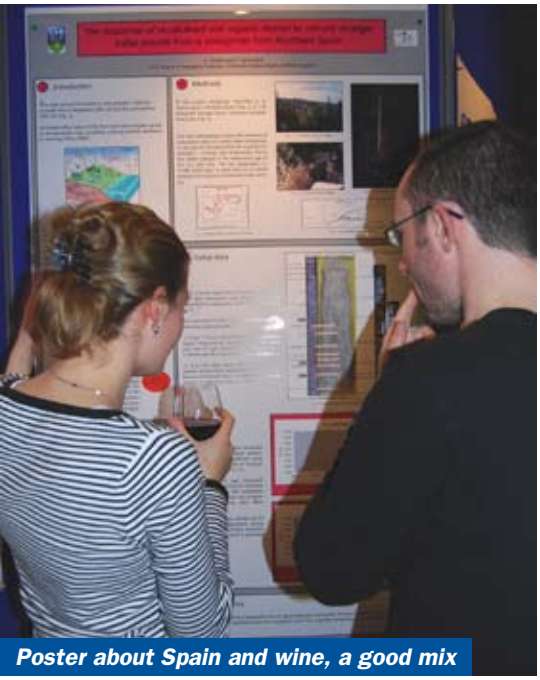
Prof Ian Fairchild, Birmingham University

Answer: **Ireland and the annual Irish Geological Research Meeting**. This year's meeting, the 51st, was held at University College Dublin, from Friday 29th February to Sunday 2nd March. It was described as 'the usual great craic' with a good attendance and great presentations. Congratulations go to the organisers for putting together such an excellent weekend.

The talks (just over 40) were wide-ranging and seemed better balanced than might have been the case in some recent years. Reasonably, because this is one of the expanding areas of research, almost a quarter of the work described related to the offshore continental shelf and mounds. The **search for offshore resources** is, of course, becoming more frantic as we increasingly eat up our land minerals and burn the fossil fuels. The companies involved with that work do not usually address this conference but you can bet they are watching the research that is being carried out.

Work by Irish researchers in overseas countries ranged from the **Americas to eastern Asia**. Again, these were about a quarter of the talks and it is good that Irish Earth science expertise is being taken onto the international stage.

That left just over half the talks about topics based in Ireland. From strain and seismology to cleavage and climate.



Poster about Spain and wine, a good mix

Amongst all this were even some results from people working in palaeontology and a paper by 'the' Higgs, on a new discovery of a trace fossil in the Old Red Sandstone of Cork Harbour, showed good basic field work is still being done.

Not to be forgotten are two lectures that were out of this world, about volcanoes on Mars and the age of the Solar System. Then, importantly, there were **the poster presentations**. As usual the posters were carefully designed and thought provoking. Remembering the earlier years of this conference with hand coloured diagrams and bits of sticky tape, the transformation due to computer graphics is just amazing.

Highlights of the meeting are always the opportunities given to get together with like-minded people from other places, comparing notes and trying out new ideas in a relaxed social environment. The guest lectures, however, are highlights at another level and so it proved.

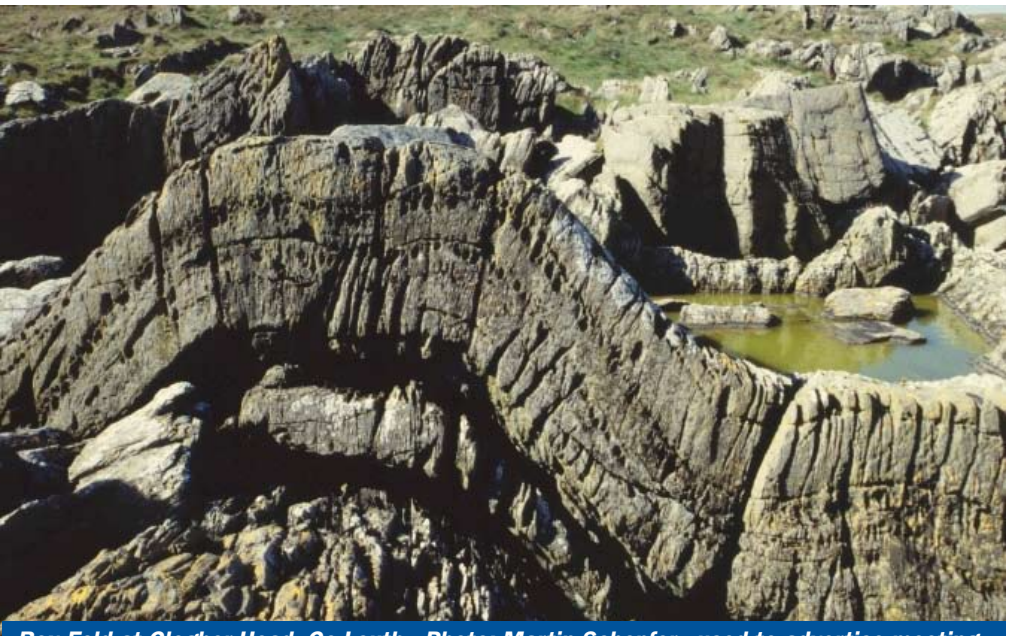
'***The geological storage of carbon dioxide – what do we need to know***?' was the question tackled by Dr. Nick Riley of the British Geological Survey, the IRGM Guest lecturer. First you have to learn that word 'sequestration', now with an environmental rather than legal meaning. As reducing the amount of carbon dioxide being pumped into the atmosphere becomes more urgent so carbon dioxide sinks are being sought. The thick Triassic halite (salt) off the shore of County Antrim is an obvious target for consideration. The British Geological Survey are leading the UK research in this topic so the lecture helped bring conference attendees up to date with progress.

Then, on Saturday evening, Professor Ian Fairchild, Birmingham University, delivered the Irish Geological Association Guest Lecture. His title said it all '***Snowball, Slushball or Zipper-rift: the Earth system as a roller-coaster in Neoproterozoic times***'. The whole concept that the planet once totally froze over is mind blowing and would hardly have been considered credible only a relatively few years ago. The talk was followed by a dinner sponsored by Tullow Oil, one of a number of generous sponsors of the event.

It is always good to end by applauding the research student efforts. ***Vanessa Johnston of University College Dublin*** won the Best Talk Prize and ***Ector Querendez of Trinity College Dublin*** won the Best Poster Prize. Congratulations to them both, and all those who took to the stage to showcase the excellent work that is being carried out by our third-level colleges. Oh, next time maybe we can find some more attractive envelopes (see illustrations) for the prizewinners' cheques.

Vanessa Johnston (UCD) receives Best Talk Prize from Susan Pyne (President, IGA)

Editor – with thanks to Sarah Procter (UCD) for supplying the photographs.



Box Fold at Clogher Head, Co Louth. Photo: Martin Schopfer - used to advertise meeting

Ector Querendez (TCD), Best Poster Prize

Ocean Floor Lavas in County Waterford

Catherine Breheny and ***Kathryn Moore*** (***NUI Galway***) *lead the way…*

The Bunmahon Volcanic Formation is located in the Copper Coast European Geopark in County Waterford. Inland exposures of the formation are few and far between but spectacular coastal sections give an exceptional opportunity to investigate seafloor volcanism. The now extinct Bunmahon volcano was generated at the margin of the shrinking Iapetus Ocean in Ordovician times, some 460 million years ago, and erupted magma compositions range from basalt to andesite. Magma composition and the local environment in which it flowed controlled the form and texture of extrusive lava. The pillow lavas, hyaloclastite and peperite, attest to the interaction of lava with seawater: Hyaloclastite (a rock of glassy shards) forms by non-explosive granulation on the rinds of pillow lava flows or by explosive hydromagmatic processes; Peperite is a complex physical mixture of volcanic and sedimentary components, resulting from magma emplacement into loose, wet, seafloor sediment. An interpretation of ocean floor magmatism is provided for the coastal geology at Trawnamoe (near Bunmahon) and Stradbally Cove:

Trawnamoe (X 427 981)

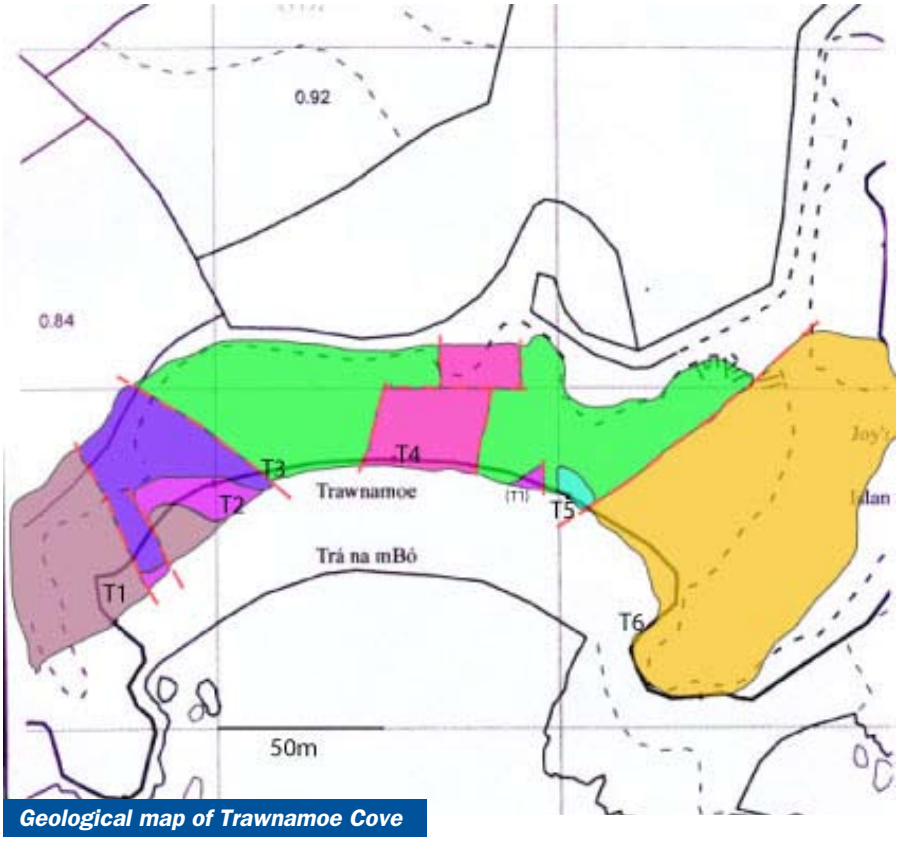
Parking is available at the beach in Bunmahon village. Ascend the hill to the east and follow the path around the top of the headland, and then descend the steep, grassy path into Trawnamoe cove. Medium to low tide is necessary for access. Start at the west end of the cove and continue east, tide-permitting.

At the west end of the cliff section on the beach, a fine-grained intrusion of basalt is cut by a fault that has been eroded to form a small cave (T1). To the east of this fault the intrusion has a sill-like form and, along its contact with the overlying ash (and crystal) tuff (T2), there is a succession from coherent magma below, through peperite, to coherent sediment above. Heat transfer from magma to the surrounding wet sediments produced a steam envelope (a zone of sediment with warm pore waters) that allowed blobs of magma rising upwards from the sill to cool in an equilibrated fluidal or globular shape. Preservation of laminations within the fine-grained sediments between these globules shows the intrusion of the underlying magma was not forceful and was driven instead either by buoyancy of the magma, local loading of sediments, or a combination of the two.

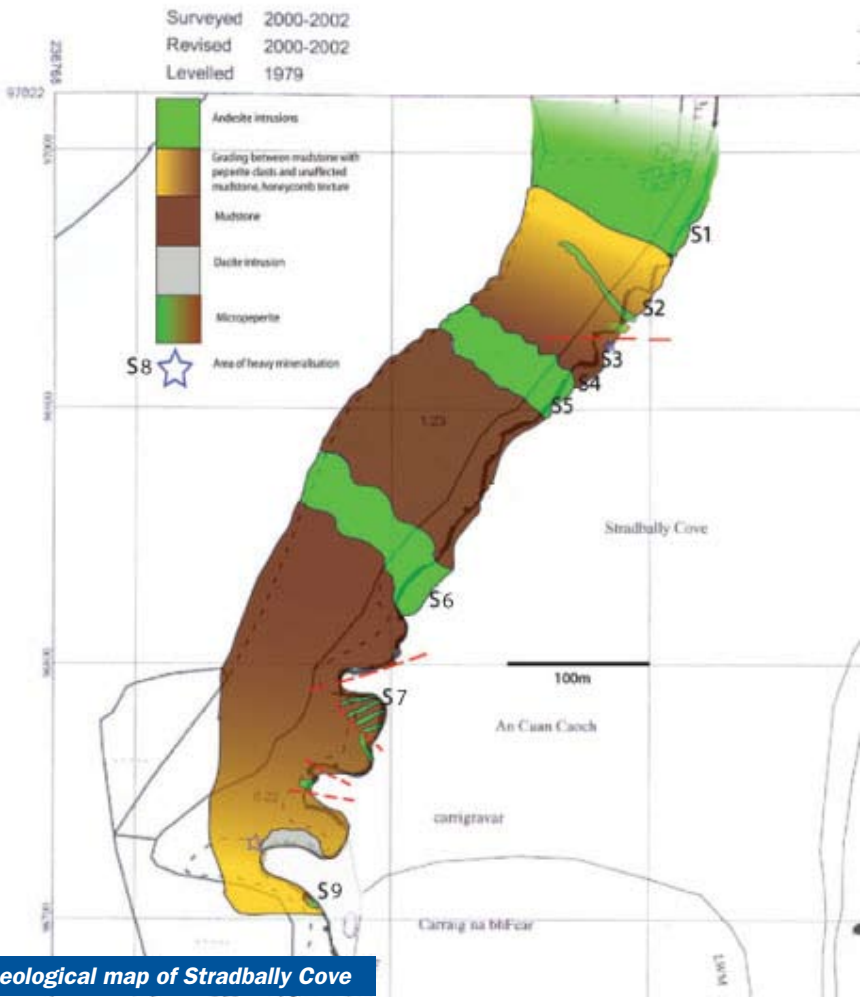
Approximately 30 metres from T2, there is a fault contact between the tuff intruded by the peperite sill and a mixed andesite and hyaloclastite lithology (T3). A massive hyaloclastite is the first rock encountered and this grades into a fine-grained green andesite, approximately a metre across with a bulbous outline, which has a sharper contact with the hyaloclastite to the east. The lithology is interpreted as a single volcanic unit, with the coherent andesite preserved internally and a more brittle hyaloclastite formed due to the interaction of the exterior of the magma with the saline fluids (in loose wet sediments or seawater). The andesite-hyaloclastite lithology makes up most of the rest of the cliff section, with some notable exceptions.

50 metres further along the beach is a faulted block of quartz-feldspar porphyry (T4). The faulted contacts obscure the original relationships of the porphyry to the surrounding andesite-hyaloclastite lithology but its more evolved felsic composition suggests that the porphyry is a later intrusion.

The most easterly of the igneous rocks on the beach shore, just before the grassy descent to the beach, includes a small area of lapilli tuff (T5), followed by some mineral veins and hyaloclastite (also along the path up the cliff). The lapilli tuff alternates between coarse and fine layers. The lapilli (composed of an aggregation of ash particles or volcanic fragments) appear as small elliptical or spherical shapes, much darker in appearance than the surrounding fine-grained tuff, averaging 1-2 millimetres in size. This lithology is interpreted as the product of a nearby explosive volcanic eruption, where ash particles, lapilli and larger rock/crystal fragments were deposited and welded together. Dependant on the level of sediments on the beach, pillow lavas may be visible beneath the lapilli tuff. These are formed when basalt lava emerges onto the seafloor, a rind forming on the outer rim when the magma comes into contact with seawater. The continuous flow of lava into this tough skin causes expansion into a balloon-shaped protrusion.



Geological map of Trawnamoe Cove

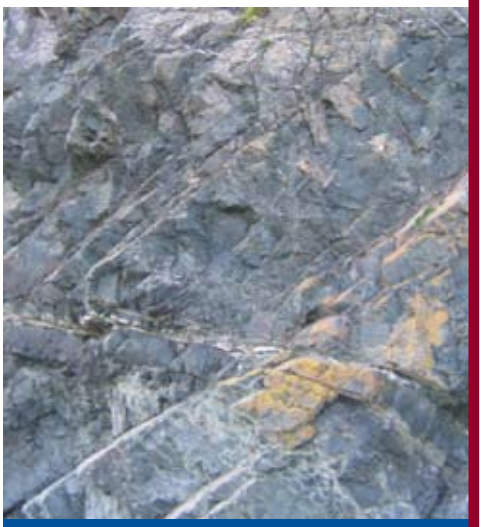


Geological map of Stradbally Cove

On the east of the grassy descent to the beach, along to the most easterly extremity of the cove, are rocks of the Old Red Sandstone (Devonian). Walk towards the shoreline around the promontory base to some small caves for the best outcrops of conglomerate, alternating with red beds of fine-grained mudstone (T6). These alternating sequences record significant changes in the environment of fluvial deposition, within a desert environment, from high energy (pebble beds) to significantly lower energy (mudstones). These Devonian rocks were deposited approximately 60 million years after volcanic activity had ceased. A major fault that strikes NE-SW up the grassy slope has displaced the rocks downward, adjacent to the older igneous rocks.

Peperite with honeycomb texture

Mineralization at the western section (T2) of Trawnamoe is observed as veins up to 20 cm thick of predominantlycalcite with some quartz, cutting across both basalt and tuff. Mineralization to the east of the bay, near the base of the path, is not as well developed as to the west and much smaller, less regular veins occur. The formation of malachite, a bright green secondary mineral associated with copper ores, is noticeable close to the outcrop of lapilli tuff (T5). In close proximity to this, the hyaloclastite has become bleached due to reaction with mineralizing fluids. The apparently greater copper content and more efficient wall rock alteration of the eastern mineralization suggests it arises from higher temperature fluids than the larger veins within, and close to, the peperite lithology (T2). Therefore, mineralization in the cove may represent two separate stages of hydrothermal activity.



Western end of Trawnamoe – succession of sill, peperite, bedded tuffs and massive tuffs

Stradbally Cove (X 969 237)

Along the road from Stradbally village toward Dungarvan, turn left at the bridge across the River Tay onto a narrow road towards the cove. Parking is available here and a short walk leads onto the beach itself. Only the western side of the cove is accessible, with the river cutting off the eastern side. Low to medium tide is necessary for access. If the tide permits, start at the north of the section on the west of the cove nearest to the car park and work south.

The first lithology encountered is a well-jointed massive light green-grey andesite. The grain-size of the andesite decreases due to chilling towards its sharp intrusive contact with mudstone (S1), where there is a very narrow (3-4mm) baked contact and the dark mudstone has a bleached appearance. Given the large size of the intrusion, its sharp intrusive contact and the small size of the baked margin, it would appear that the magma intruded into sediments that were at least partly consolidated and dewatered. Prior to reaching the next andesite intrusion

Mixed morphology peperite

there is an area, approximately one metre wide, of peperite (S2) in mudstone with a mottled appearance. Clasts of volcanic rock occur as pale, irregular and angular shards several centimetres long within the dark mudstone, indicating that fragmental shattering occurred. These clasts are similar to the underlying intrusion but it is not known if this is the source intrusion of peperite or a later intrusion. The contact between peperite and the intrusion is relatively sharp, and the contact between peperite and the mudstone is gradational but with some rare clasts of andesite preserved in the surrounding mudstone. The honeycomb texture, with randomly orientated cracks and a mottled appearance, may have formed as a consequence of fluid migration through unconsolidated sediment, driven by the heat of magmatic intrusions. This honeycomb texture is not present, or has been destroyed, in the mudstone within which the magmatic clasts of the peperite are present. In contrast to the previous intrusion (S1), the peperite represents an earlier phase of magma injection when the sediment was softer and more hydrous.

Walk approximately 50 metres south from S2, past a fault and some good vein mineralization, to see a peperite with a different texture (S3). The source of the magmatic clasts in the peperite is visible as an irregularly shaped intrusion of pale rock, with barbed apophyses (fingers) approximately 3cm wide. The peperite clasts were fragments of magma that separated from the apophyses and they are also pale, with angular, barbed outlines. A small distance further south (S4) the mudstone has neither been intruded by magma nor suffered any of the effects of heating by magmatic intrusion. It is therefore less competent than elsewhere: it is more strongly weathered and it is preferentially cut by faults.

The next andesitic intrusion (S5) is a dyke with a chilled margin and sharp intrusive contacts, indicating that the sediments were more lithified and that the dyke belongs to the later intrusive phase. Walk past approximately 150 metres of mudstones that have not been intruded to a second large andesite dyke (S6) where the contact between the intrusion and sediment is irregular and bulbous in places but no obvious interaction has taken place between the two. This suggests intrusion at a time when the sediments were still relatively soft but had not been completely lithified. These outcrops suggest ongoing injection of dykes while the sediment is becoming increasingly lithified: intrusion into loose, wet sediment produces peperite clasts; intrusion into partially consolidated sediment produces undulose contacts; intrusion into lithified sediments produces sharp, linear contacts with chilled margins. Continue southwards to see more dykes through the undisturbed pyrite-bearing mudstone (S7). Minor faults cut the narrow dykes with straight edge contacts and the same andesitic composition as previously. These dykes have a finer grain size simply due to the smaller volume of magma in the narrower dykes, and therefore shorter cooling time.

Mineralization along fault planes is observed principally within small caves (S8), where preferential erosion has occurred due to fault movement, and quartz & calcite veins are up to 20 centimetres in thickness. This is a similar form of mineralization to that at the western end of Trawnamoe cove.

Close to the low tide mark, nearing the end of the beach, there is a different type of peperite with andesite clasts on a much smaller scale than previously recorded and it is here termed ‘micro-peperite’ (S9). Clast shape in this instance ranges from fluidal to sub-angular, but the more important feature is the size of the

Micropeperite

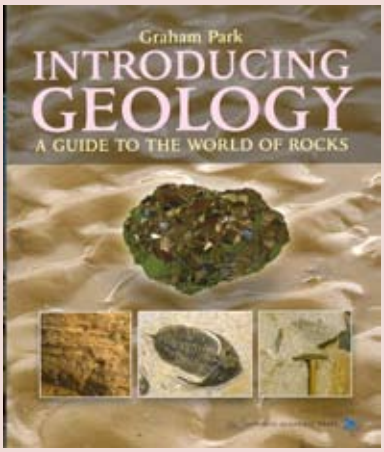
clasts, which have a maximum size of one centimetre. The small size of clasts might perhaps indicate a much higher cooling rate then in other peperites, with the disintegration of magma occurring by a range of processes within particularly fine-grained host sediments.

Summary

Magmas and sediments are observed interacting to form peperite, for both an intrusion of basalt into volcanic tuff (Trawnamoe) and an intrusion of andesite into mudstone (Stradbally). The shape of the magmatic peperite clasts, also called juvenile clast morphology, is dependent on variables such as host sediment grain size, rate of injection of magma and temperature of intruding magma. The temperature of the basalt magma was most certainly greater than that for the andesite magma and it is likely that the finer-grained mudstones, containing more water than the crystal tuffs, removed heat more effectively. Hotter magmas (Trawnamoe) with a larger heat capacity had a slower cooling rate and formed more fluidal shaped clasts. This was also dependent, however, on the rate of injection because a slower intrusion will form a stable film (steam envelope) around clasts whereas a more forceful intrusion will cause a shattering or fragmentation of magma. Greater water content in sediment (Stradbally) can act to increase cooling rate and produce more explosive magma-sediment interactions, also with fragmentation or shattering of lava to form angular clasts. Another factor that may influence the development of clast shape is the relative volumes of magma and sediment. Small volumes of magma and large volumes of sediment in the peperite and high initial water content in sediment caused the more angular clast morphology at Stradbally Cove due to more rapid cooling. The honeycomb texture within the mudstones is evidence, not only of the initial high water content, but also of fluid migration (dewatering of sediments) driven by the heat of intrusions. At both the peperite localities of Stradbally and Trawnamoe, there is a significant amount of vein mineralization.

Postgraduate research is ongoing at the National University of Ireland, Galway, to examine the relationship between fluid migration driven by igneous intrusions into the seafloor and the development of hydrothermal mineralization.

Book Review



Introducing Geology: a guide to the world of rocks by Graham Park

Published by Dunedin Academic Press 2006, pp 134 ISBN 9781 9037 65647, Price £14.99

This book provides a very good introduction to geology, explaining all areas succinctly and clearly while using the minimum of scientific jargon. The diagrams and photographs used throughout the book are well chosen and fully compliment the text.

As all rocks are "*made up of minerals*", where better for the author to begin his introduction to "the world of rocks" than by describing their different mineral building blocks and also the gemstones, which the general reader is familiar with.

The book then moves rapidly on to the various geological processes that through time have given us today's landforms. First volcanic activity is comprehensibly yet simply explained. Chapter 3 then deals with the shaping of the land and describes the various types of weathering: erosion by the rivers, seas and wind and the effects of ice on rocks already present on the landscape. So leading seamlessly on to the next chapter and the various types of sedimentary deposits formed as a result.

Plate tectonics can be difficult to understand. The author deals with the evolution of this concept and, with the aid of excellent diagrams, has succeeded in explaining a difficult subject using simple language - without detracting from the immense importance of the subject.

Earthquakes, faults and rock deformation are then tackled in short concise chapters with superb diagrams and photographs.

Geological Time can be difficult to grasp as about 4,600 million years are spoken of and how complex life on earth began around 570 million years ago, at the beginning of the Cambrian period. The stratigraphic column and radiometric methods of dating rocks are described. Mention is even made of the Creationists' age for the earth.

No general book on geology would be complete without mentioning fossils. Chapter 9 describes what fossils are and how they are preserved. The different fossil groups found and their uses in dating and correlating rocks is discussed.

A short chapter on the geological input to industry follows. It describes: oil and gas production; ore and mineral retrieval from the earth and their uses; how rocks and other natural materials are used in the building industry; the importance of the properties of different rock types in civil and structural engineering; and how rocks act as storage for the "*critical resource*" of water.

The book ends with the history of the earth in greater detail, bringing together most of the concepts explained in the earlier chapters. Then, for a book of its size, there is an excellent glossary.

Introducing Geology will provide the general reader with a perfect introduction to "the world of rocks".

Rosalie Grainger

Earth Science Conservation Review – an update

Pomeroy, Co Tyrone, hummocky glacial moraine

What is the Earth Science Conservation Review?

The Earth Science Conservation Review (ESCR) is the body of work coordinated by the Northern Ireland Environment and Heritage Service (EHS) used to identify and report on the most important geological and geomorphological sites in Northern Ireland. It is the means whereby geological sites in Northern Ireland are assessed to determine their importance to geology and hence to earth science conservation.

An overview of the programme can be found on the EHS website at - www.ehsni.gov.uk/landscape/earth_science/conservation.htm while site reports can be accessed on www.habitas.org.uk/escr.

The ESCR exercise identified 329 discrete features of at least national (Northern Ireland) significance including 221 solid geology, 53 Pleistocene and 55 geomorphology (active and fossil).

Dromore, Co Tyrone, Devonian sandstones

Note that features refer to discrete geological interests contained at a site. An individual site may contain a number of such features so that the total number of geological sites represented by the ESCR is less than the total number of features; it is estimated that 273 sites are involved (the actual number depends on final site boundaries and relationships with biological sites).

While the ESCR was a significant undertaking, it was in fact not an end point from EHS's perspective. The work allows us to meet our statutory obligations to designate 'geological and physiographical' Areas of Special Scientific Interest (ASSI). The overall objective is to designate all ESCR sites as ASSIs – this then confers legal protection on them and places restrictions on the kinds of activity that can take place there.

So how is the designation programme faring?

To date, EHS have designated 251 ASSIs of which 81 are either exclusively or partly geological in nature. This is some 30% of the anticipated number of ASSIs required to designate the ESCR site series. Existing ASSIs account for 130 ESCR features – some 40% of the total identified. Additionally we are committed to ensuring that a minimum of 8 further geological sites is designated each year for the next 9 years. Of course additional designations related to the biological programme will also 'deal with' further geological features that fall within habitat sites. It is likely that over 100 ESCR features will be designated over this time, which will mean some 70% of the programme will be completed by 2016.

The emphasis so far has been on designating particularly important or vulnerable localities. Well known examples include the internationally renowned Palaeogene basalt series at the Giant's Causeway, the Carboniferous coalfield at Ballycastle and the dramatic volcanic series at Carrickarede, all in County Antrim. More recent designations include the classic hummocky moraine at Pomeroy, the prominent moraine and kettled topography at the Murrins, and the prominent Devonian sandstones at Dromore, all in Co. Tyrone.

Future of the ESCR

While the emphasis is presently on site designation, additional activities include site monitoring and management. Monitoring is undertaken at least once every year to determine if any damaging activities have taken place. A more detailed assessment is made once every 6 years to ensure that the geological interest is still intact. Management work includes responding to specific incidents e.g. fly-tipping and to remedy any problems identified through the detailed site assessment. Actions can include selective clearance of vegetation and substituting extracted scree or beach gravel with bought-in aggregate at sensitive sites.

It was always intended that the ESCR is dynamic with the site series being periodically reviewed and updated to reflect new geological investigations. Indeed, GSNI are about to commence a 3-year contract let by EHS to selectively review the ESCR sites, especially in the light of recent remapping.

Finally, making the findings of the ESCR programme publicly accessible has always been a high priority. While all reports can be found via the Ulster Museums Habitas website (address above), it is hoped to develop this facility to make the system more user friendly.

Brief updates on EHS's progress will appear in future issues of Earth Science Ireland.

We always welcome comment and discussion about our programmes. Please let me have any thoughts on the ESCR work – email details below.

Ian Enlander, Earth Heritage Officer, Environment and Heritage Service ian.enlander@doeni.gov.uk

Ian Enlander

THIS IS MY STORY

By **Laura Collins**

Laura studied at St Pius X College, Magherafelt and St Mary's Grammar School, Magherafelt before going to Cardiff

My name is Laura Collins, from Co. Derry. I am a third year student studying for a ***MESci*** in Earth Sciences at ***Cardiff University***. This is my story. How I came to study this course, what it has to offer and my hopes for the future.

I began my studies in Cardiff in September 2005 as an enthusiastic first year who couldn't wait to start her degree. I choose Cardiff University because of the structure of its MESci course and its emphasis on fieldwork. The first year was a general year studied by all degree schemes in the School of Earth and Ocean Sciences, to help students get to grips with the basics of earth science. I found this particularly useful as my school, like many in Northern Ireland, did not offer A-level geology.

So what was the motivation for me to study geology? My interest stems from a curiosity, I think we all have, about the workings and wonders of the world around us. At one stage or another we have all stopped to marvel at something we have seen in the landscape around us, whether it is a small well-rounded pebble on a beach or the sight of magnificent cliffs that take your breath away. We have all watched the documentaries about volcanoes, earthquakes, and tsunamis and been in awe at their power and wondered, how and why does that happen? Well, in my case, I decided to find out!

The general response from most people when they ask what I study is '*Oh, rocks and stuff*'. To which I reply '*Yes rocks, and an awful lot more*'. It's the "stuff" that makes this degree so interesting. I wasn't aware how broad earth science was until I started to work my way through my first year modules. These modules covered a wide range of subjects such as life and earth history, environment and society, natural resources and energy, geoinformatics, and maps, charts and fieldwork.

One of the most important elements in my degree is fieldwork. There is a significant emphasis on fieldwork in all Cardiff earth science courses. During the first year there are scheduled field trips every week to areas all over Wales and southwest England. These field trips are where most of my learning has taken place. Everything taught in lectures becomes real and you really begin to understand the geology around you. This was reinforced on a week-long residential fieldtrip in my first year, to the Isle of Arran off the west coast of Scotland. This was an intensive, but thoroughly enjoyable, week of fieldwork, along with projects and follow-up work. It was one of the most challenging field trips I have ever participated in, but was by far the most rewarding. During my degree I have had the opportunity to go on fieldwork to Devon, Dorset and Cornwall as well as the Cantabrian mountains in Spain. My independent mapping project last summer focussed on part of the west coast of Portugal, and shortly I will have the opportunity to study the ophiolite complex and ore mineralisation on Cyprus.

Although there was no dominant reason why I originally decided to study earth sciences, I have found that my particular interests lie in the realm of volcanic and magmatic processes and plate tectonics. Igneous rocks hold so many secrets of their formation and magmatic evolution, sometimes even in the smallest crystal or in their isotopic makeup. I find it fascinating to be able use geochemistry to unravel the story of how these rocks formed. This interest has led me to choose an igneous topic for my year 4 project. Under the supervision of Andrew Kerr, I plan to assess the tectonic setting and petrogenesis of the Ordovician-age Tyrone Igneous Complex. It will be great to be able to apply the geological knowledge I have acquired during my degree to shed new light on an igneous complex that crops out close to where I grew up.

Laura in Portugal

I am also very interested in the topical issue of global climate change. During my second year I took an extra module on the ocean-atmosphere system. This taught me about the generation of weather systems, the complex interaction between the atmosphere and the oceans. I have extended my work in this fascinating area into the third year where I am studying a module on global climate change. The freedom to do this within my course is wonderful.

I have thoroughly enjoyed my course in Cardiff and am looking forward to the rest of my degree, especially my research project next year. **The future**? After graduating, I hope to study for a PhD in igneous petrology and ultimately pursue a career in research.

ES2k wishes Laura a very happy and successful future

Irish 'Rock Stars'

Patrick Wyse Jackson, Trinity College Dublin, continues his series

Sydney Mary Thompson (Madame Christen) (1847–1923)

This year, 2008, is the International Year of Planet Earth and to mark this the Geological Survey of Ireland has, amongst other events, organised a competition for schools. Children are being asked to identify a glacial erratic in the locality. This reminds us of the aspirations of the committee established in the 1870s by the British Association for the Advancement of Science (BAAS) to report on the distribution of such exotic blocks of stone. This was important and topical work whose importance can be measured in that during the period 1874 to 1908 the Association granted the considerable sum of £157-16*s*-6*d* to support the study.

The work of this Committee was championed in the north of Ireland by a number of ladies led by the energetic and able Sydney Mary Thompson (1847–1923) (Figure 1) who was assisted by Mary K. Andrews (1852–1914) daughter of a professor at Queen's. They formed part of the Geological Section of the Belfast Naturalists' Field Club which had been founded in 1863.

Thompson was born at Whitehouse in County Antrim one of several children of James Thompson, a Belfast linen merchant. She was a niece of the naturalist William Thompson. Following her schooling and a three-year period spent in Dresden, she trained at the Belfast Government School of Art and in London and later joined two Belfast art groups.

From an early age Thompson was a keen student of glacial features and on 29th September 1894 she was elected a member of Glacialists' Association. In the same year she joined the Geologists' Association. Quickly she began to make a mark as a geologist. In July 1895 she organised a visit to the region by the Geologists' Association and during the trip the visitors enjoyed her hospitality at her father's house at Macedon Point, north of Belfast.

Between 1893 and 1899 the Belfast group mapped and named erratics, and collected small samples of these exotic

Figure 1 - Sydney Mary Thompson (Madame Christen) at Murlough Bay, Co. Antrim in 1898 (courtesy Ulster Museum).

blocks of rock. They wished to determine the direction of ice-flow in Ulster. Their results were written up by Thompson, published in the *Proceedings* of the Belfast Naturalists' Field Club, and they also contributed their findings to the BAAS committee. Thompson's major find was that of a piece of Ailsa Craig microgranite at Moys, inland from Limavady, Co. Londonderry which demonstrated the furthermost westerly extent of the Irish Sea Glacier. Small pieces of this distinctive granite which contains tiny flecks of the blue-coloured mineral rebeckite, was carried by the Irish Sea Glacier southwards and was incorporated into glacial sediments along the east coast of Ireland (Figure 2). Its presence allowed geologists to trace the flow of this long-melted glacier.

Today the Belfast group's collections of erratics are in the Ulster Museum where the small samples are contained in dove-coloured boxes whose lids are neatly held down with pink ribbon (Philip Doughty, personal communication, July 2007 – who also remarked to me that the colour of the ribbon suggested a feminine touch).

Figure 2 - Distribution of Ailsa Craig granite erratics in Ireland and Britain (from W.B. Wright, The Quarternary Ice Age, Macmillan, London (1914), p.56).

In 1901 Mary Andrews published an important paper in which she identified twelve species of fossil shells and foraminifera in the glacial sands at Moel Tryfaen in north Wales. The importance of this site is that it is high above sea level and demonstrated the ability of ice to deposit marine shells at high elevations.

At the age of fifty-three Sydney Mary Thompson married a Swiss artist Rodolphe Christen and was from then on styled 'Madame Christen'. For two years following their marriage they travelled throughout Europe and then settled near Aberdeen. Unfortunately they enjoyed only a brief marriage; Rodolphe died at home on 7th September 1906 aged only 47. Four years later his widow published a biography of her husband in which is reproduced his pencil drawing of her cutting their wedding cake whilst on a picnic. Appropriately she is sheltering in the shadow of a large erratic.

Sydney Mary Thompson died of heart-failure in Landudno, on the north coast of Wales on 16th July 1923.

Further reading: This paper is a synopsis of a forthcoming paper that documents the lives and work of several female geologists who worked in Ireland. This will be published by WITS (Women in Technology and Science) in 2008. For more information on women geologists in Ireland see Higgs, B. and Wyse Jackson, P.N. 2007. 'The contribution of women to geological studies and education in Ireland', In C.V. Burek and B. Higgs (eds), *The role of women in the history of geology*. Geological Society, London, Special Publications **281**: 137–153.

Patrick N. Wyse Jackson
Trinity College, Dublin

RARE MINERALS FOUND AT WHITESPOTS LEAD MINES, Co DOWN

Norman Moles (University of Brighton)

For a short period in the mid-nineteenth century, the Conlig–Whitespots Lead Mines near Newtownards, County Down, produced more ore than the combined output of all other lead mines in Ireland. The mines have long been flooded and underground collecting is now impossible as the shafts have been capped. It is still possible, however, to find crystals on the spoil heaps in what is now the Whitespots Country Park. The mine site is a Site of Special Scientific Interest in part because of its interesting mineralogy. Small but beautifully formed, transparent crystals of the barium zeolite mineral ***harmotome*** $(Ba,K)_{1-2}(Si,Al)_8O_{16}.6H_2O$ occur rarely at the site. The eminent mineralogist Sir Arthur Russell first noted these crystals in 1927.

Recently, while preparing an article on the minerals found at the Lead Mines for publication in the Journal of the Russell Society (named after Sir Arthur), I realised that another mineral was present with different crystal shapes. Analyses showed this mineral to be another barium zeolite, ***edingtonite***, $Ba(Al_2Si_3O_{10}).4H_2O$. Edingtonite is rare worldwide and hitherto has not been described from Ireland. It has been overlooked at the Lead Mines because it occurs as diminutive crystals, typically one-tenth of a millimetre in diameter, encrusting other crystals within vugs in the mineralized breccias that hosted the lead ore. Indeed, I previously thought of these encrustations as a nuisance, detracting from the appearance of Sir Arthur's specimens! The breccias also contain barite, calcite, dolomite, clay minerals, quartz, galena, sphalerite, pyrite and chalcopyrite.

In a previous publication, I suggested that harmotome formed during a phase of hydrothermal activity associated with intrusion of a Tertiary dolerite dyke through the ore-bearing breccias that are of probable Carboniferous age. Examination of further specimens suggests that harmotome crystallised during both the primary phase of ore formation and the subsequent dyke intrusion. Edingtonite has not been found together with harmotome, but it is likely that the edingtonite was formed during the dyke intrusion event as hot, barium-rich water circulated through vugs in the breccias.

A sugar-like coating of white crystals of edingtonite on rhombic dolomite crystals in a specimen from the spoil heaps

Beautiful cross-shaped prisms of the mineral harmotome from the spoil heaps

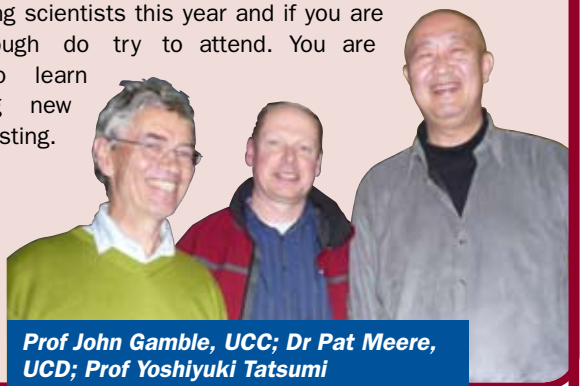
EARTH'S MEMORY

'The answer lies under the sea' has to be true for many geological conundrums. There is a 'memory' in the sediments, deep rock and along the oceanic ridges that has yet to yield its secrets. That is why deep ocean drilling is so exciting, apart from the potential economic resources.

On Thursday 14th February in the Geology Department of University College, Cork an audience was treated to a talk by a very distinguished Japanese geoscientist, Professor Yoshiyuki Tatsumi. He is Programme Director of the Institute for Research on Earth Evolution, part of the Japan Agency for Marine-Earth Science & Technology.

His topic was 'Drilling into the Memory of Earth'. The lecture is one of a series supported by the International Ocean Drilling Programme. He described drilling into the deep crust of an ocean arc to understand how continental crust is born. The ship available for such research has, and needs, the capability to drill 7,000 metres into the ocean floor.

Watch the IYPE Website for other talks by outstanding scientists this year and if you are near enough do try to attend. You are bound to learn something new and interesting.



Prof John Gamble, UCC; Dr Pat Meere, UCD; Prof Yoshiyuki Tatsumi

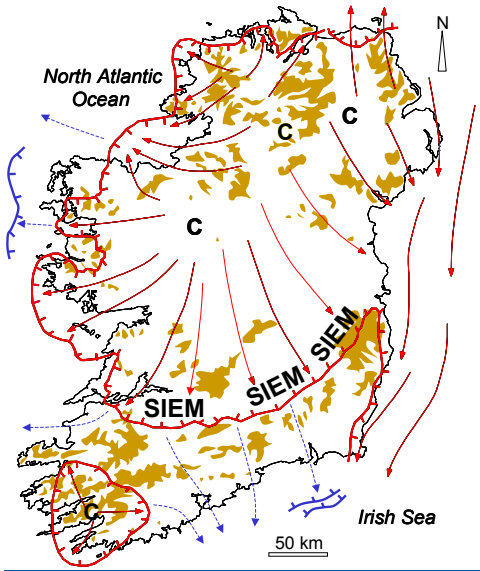
GLACIATION MELTING AWAY

Whither the Munsterian?

Traditionally in Ireland, surficial glacial sediments have been assigned to the last two glacial stages of the Quaternary based largely on their visual 'freshness' (e.g. Rosmore). Sediments formed during the most recent of these stages (named in Ireland as the Midlandian, between about 22,000 - 13,000 years ago) cover the northernmost two-thirds of the island and form such distinctive features as drumlins and eskers. By contrast, sediments in southernmost parts of the island are often highly weathered and decalcified, are commonly disturbed by periglacial reworking, and form features that have subdued relief.

This 'freshness' approach, developed in the early part of the Twentieth Century, led to surface sediments throughout Ireland to be assigned to deposits of Younger Drift (fresh) and Older Drift (subdued). This approach was used by the Quaternary geologist J.K. Charlesworth (Queen's University, Belfast) to demarcate the boundary between Younger and Older Drifts that, he argued, marked the maximum southernmost extent of the Midlandian ice sheet. In a paper in 1928 Charlesworth identified a broad set of end moraine ridges extending west to east across the country (the *South of Ireland End Moraine*; **SIEM**) that represents this boundary (See map). He argued that the sediments located southward of the SIEM were of Munsterian (penultimate glaciation) age. Later workers, such as G.F. Mitchell (from Trinity College, Dublin), confirmed this by observing differences in the distribution and character of periglacial structures inside and outside this limit. For example, periglacial structures are more common outside the SIEM, and include unusual forms such as open-system pingos. Other workers, such as F.M. Synge (Geological Survey of Ireland), showed that the SIEM was not a continuous and single-age moraine, but in fact comprised several discontinuous and overlapping moraine systems of different ages. But these studies still helped reinforce Charlesworth's original ideas because they showed the differences inside and outside the SIEM.

Remarkably, this view of Younger and Older Drifts and the role of the SIEM continued largely unchallenged until well into the 1990s. At this time, more detailed studies of sediments exposed along the south coast of Ireland (e.g. Ballycroneen) showed that these sediments are in fact 'fresh' and record an interplay between native Irish ice and the south-going Irish Sea ice stream during the last glacial cycle, not the penultimate one. Modelling and dating evidence onshore, and geophysical and seismic evidence offshore in the Celtic Sea, has also subsequently confirmed this view. Additionally, other recent work has also shown that the Cork/Kerry ice cap, which Charlesworth and others thought was separate from the ice sheet during the Midlandian, was in fact both joined to it and extended offshore as the main ice sheet did.



Late Midlandian ice margins and ice flow (red) – after Stephens et al 1975 – and maximal offshore ice positions (blue)

So what of the Munsterian? Does it still exist? Based on glacial sediments alone, we aren't sure: it is probable that surficial sediments south of the SIEM are of early Midlandian age, matching with similar sediments known from the north of Ireland. It is unclear whether, south of the SIEM, older glacial sediments are exposed on the surface, or whether they are buried at depth beneath younger sediments, or whether they do not exist at all. What we do know, however, is that the SIEM is not a maximal late Midlandian ice limit but most likely represents a major stillstand during Midlandian ice retreat.

Glacial sediments at Rosmore Quay, Co Mayo, deposited by late Midlandian ice

But the concept of the Munsterian may still be important. This is because its stratigraphic position is related closely to the position (and thus age) of interglacial organic sediments. Fourteen sites across Ireland have organic plant material with floristic affinity to the penultimate interglacial (named the Gortian in Ireland). No site, however, shows clear evidence for the last interglacial (thus the period separating the Munsterian and Midlandian), which is a big problem. Of course, if the Munsterian doesn't exist, then the Gortian is in fact the 'last interglacial' in Ireland. Although this is not a solution to the problem of the Irish Quaternary, it highlights the fact that we know very little about the pre-Midlandian. Future sedimentary and dating studies need to address this crucial time period in the lead-up to the last glaciation. These studies can be usefully informed by deep-sea and ice-core records which show the hemispheric-scale climate drivers on terrestrial glacial events in Europe.

Dr Jasper Knight, Department of Geography, University of Exeter. j.knight@exeter.ac.uk

References: **McCabe, A.M. 2008**. Glacial Geology and Geomorphology. The Landscapes of Ireland. Dunedin Academic Press, Edinburgh. **Stephens, N., Creighton, J.R. and Hannon, M.A. 1975**. The late-Pleistocene period in north-eastern Ireland: an assessment 1975. Irish Geography, 8, 1-23.

Glacial sediments at Ballycroneen Strand, Co Cork, south of the SIEM but likely deposited by late Midlandian ice

STONE AND OUR BUILT HERITAGE

New database now online www.thenaturalstonedatabase.com

"There is a close connection between Geology and Architecture: … The Study of Geology is particularly appropriate for the architect, who, in applying the various materials of the Earth's crust in the realisation of his designs, should be familiar with their origin, if he would successfully employ them in securing variety, beauty and the permanency of his structures…'

William Gray, addressing the Royal Institute of the Architects of Ireland, 1869

Albert Memorial Clock, Belfast

Stone is a natural, complex material of almost infinitive variety - that's its attraction as a building material but also causes a variety of failings and problems. Understanding how stone performs in the environment is vital to building, repairing and restoring masonry buildings, be it as a modern thin skin on a steel frame or an ancient solid walled monument.

We have a long history of the use of stone for building In Northern Ireland. Our varied geological foundation has provided a wide variety of stone. It used to be the local availability of a particular rock type that dictated the building stone giving each area and county its own distinctive character of built heritage. The Mourne and Newry granites, the greywacke sandstone of Down and the black basalt of Antrim dominate the random rubble and dressed stonework of buildings and monuments throughout these counties. Scrabo sandstone from Newtownards, with its distinctive pink and yellow hues and sedimentary structures and clay lenses, and the buff sandstones of Dungannon and Ballycastle dominate the dressed and intricately carved stonework on much of our ecclesiastical heritage. In Fermanagh and Armagh the fossil-rich grey and pink Carboniferous limestones are used from both the simplest vernacular building to the grandest Cathedral.

The full range of rock types have been used as building stone since Neolithic times. As transport systems developed in the 19th and 20th centuries, stone was moved further around the country as well as being shipped in from further a field for construction of the more prestigious buildings such as town halls, churches and banks. Belfast's built heritage has a full range of Scottish Carboniferous sandstones and English Jurassic limestones used from the mid-19th Century. Until the railway network was well established the easiest and most economical way to transport stone was via waterways rather than overland. Today we are importing stone from all over the world including India, Portugal and China for cladding and paving.

Carlisle Methodist Church, Belfast

Aesthetics, Artistic Quality and Construction

The best artist has that thought alone which is contained within the marble shell, the sculptors hand can only break the spell to free the figures slumbering in the stone

Michelangelo, 1475-1564

Stone may have been used for generations because of its strength and longevity but its aesthetic qualities are just as important. It can be worked, dressed and carved to express the intent and inspiration of architect, sculptor and mason. Accordingly the aesthetics of a building is both on the macro scale - the architectural composition -, and on the micro scale – the individual carved stone. Each stone can be a work of art in its own right.

Guild Hall, Derry

The value of a stone building can be measured not only by its overall quality and the reputation of the architect, but also by the skills of the masons and sculptors. Of all trades and crafts, it is

Janus Statue, Fermanagh

in stonemasonry that the hand, eye and intellect of the craftsman become such a vital physical expression in a building. The medieval masons, of course, were the architects, the masters of building, combining their vision of the whole composition with a deep understanding of how it was to be built.

It is crucial to the understanding of a stone building to know how it is constructed, how the components are crafted together and how this intricate combination of the parts contributes to the final aesthetic and artistic qualities.

Queen's University Library

Diagnosing Decay: The Nature of Stone Weathering

The drops of rain make a hole in the stone not by violence but by often falling

Lucretius, circa 99BC – 55BC

All buildings age and weather through time, sometimes gracefully, sometimes destructively. The weathering and aging of stone can add to its beauty and character. Each building develops a unique patina of age, based as it is on a singular combination of geology, time and environment. It is, however, not easily measured in a scientific way. People will hold different opinions about whether a stone's appearance has improved with time. Excessive weathering can give an impression of neglect, which can be the start of a self-defeating spiral. These subjective perceptions tend to follow cyclical fashions and the results can be enormously destructive. Witness the excessive cleaning of sandstone buildings in Glasgow, amongst other northern industrial cities including Belfast, in the 1970's and 1980's. The blackened crusts on sandstones and limestone, the legacy of a century of heavy industrial pollution, robbed many fine buildings of their visible quality, texture and character, all too frequently leading to demolition.

The result was a conservation-based backlash and a presumption against cleaning which is still prevalent today. Excessive cleaning removes the patina of age, causes loss of historic fabric and can start a self-destructive cycle of decay. Not cleaning, however, can leave destructive encrustations, salts and organisms in place that can, more subtly, contribute to a perceived loss of value of a building.

Preferential decay of sandstone against cement mortar

To clean or not to clean? To replace or conserve stone? Decisions that for an historic building must not be taken lightly or based solely on the current fashion. It can be a most difficult problem for a building owner or architect but there are key bits of information that need to be established before a conclusion is reached.

An ancient weathered stone statue will inevitably decay to the extent of losing its unique markings. Should it be brought into a museum and replaced by a replica? This will preserve the original but it will be disassociated from a location that is commonly crucial to its understanding. Should it be preserved *in situ* within a protective enclosure? Again this will inevitably break its connection to the landscape. Should it be treated with a chemical consolidant to reduce decay? Should a copy be made now, before it weathers too much, and the original just left to slowly dissolve? All four solutions could be right, or wrong, but again reaching the best conclusion means properly understanding and weighing up all the factors.

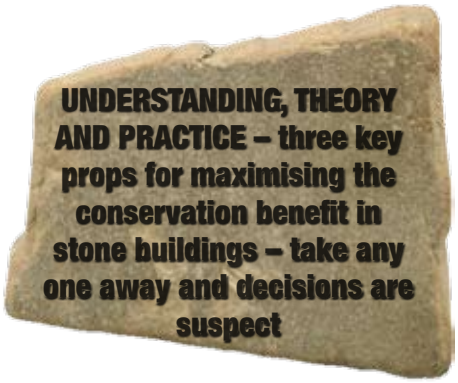
Scaling sandstone

St. Mary's Priory, Devenish Island, Co Fermanagh

Stone Weathering Database Project

'Science is facts; just as houses are made of stone, so science is made of facts; but a pile of stones is not a house and a collection of facts is not necessarily science'

Henri Poincaré 1854 - 1912



Understand a building and its context, take a rigorous scientific approach, and apply sound practical knowledge. Take these actions and some of the best of our historic natural stone buildings will be properly looked after and equipped for the 21st Century.

The 19th and early 20th Century architects and builders of Ireland were well informed on the use and availability of stone. Publications such as '*A Practical Guide and Ancient Architecture of Ireland*' by George Wilkinson (1845) and '*Economic Geology of Ireland'* by Kinahan (1889) provided invaluable information on stone resources. Nowadays, however, stone is only one of many materials used in construction. Nevertheless, we still use natural stone for our most prestigious and often award-winning new buildings. Increasingly, we are questioning the sustainability of the materials used in construction and the high levels of energy required to produce glass, concrete and other modern construction materials.

For the 21st Century the agenda has changed, with much more focus is on stone conservation. Yet there has been a lack of information about most buildings and such data as it exists is not in one place. These days the way we deliver information has also changed - information needs to be available to architects, building owners and contractors at the click of a mouse.

To tackle this problem for Northern Ireland the Industry-Research Partnership of a leading architectural practice - *Consarc Design Group and Queen's University Belfast* have produced a GIS-database '**The Natural Stone Database for Northern Ireland**' for the Environment and Heritage Service of Northern Ireland (funded by the EU Building Sustainable Prosperity Programme). The database provides information on:

Building architect, date of construction, description of building, GPS co-ordinates

Stone rock types used, samples for petrography where possible to link with original quarry

Condition Assessment recording the extent of the main decay features of the stonework

The database is the culmination of a 2-year programme of surveying of buildings and monuments, stone analysis and testing, and practical experience. Key to the project is the identification of the extent and nature of stone decay on a building as this is the first step to the development of an appropriate conservation strategy. Each survey incorporated the 'Staging System' method for stone assessment developed by Dr. Patricia Warke at Queen's. This common assessment method provides a base-line record of the stonework condition against which to monitor further progress and gives an early warning of the need for any future remedial action.

The database will be freely available online (www.thenaturalstonedatabase.com) to architects and building owners in March 2008. ***The project will also publish a map 'Building Stone of Ireland' with the Geological Survey of Ireland in May 2008.***

Exemplary stone repair, like most aspects of conservation, is not the preserve of any one profession or trade, but rather the product of a genuine collaboration between: architects, archaeologists, geologists, analysts, stone masons, structural engineers, surveyors, historians, maintenance officers and habitat ecologists.

To restore and conserve stone structures is a complex process, and to do it properly requires experience, skilled workmanship and specialist knowledge of materials. This project is a 'stepping stone' that provides practical information to the custodians of our heritage and those that work to restore and conserve them. We hope it will be well used and know that by taking the correct decisions not only will our built heritage be conserved but the long-term costs involved, much coming from the public purse, will be minimised.

By much slothfulness the building decayeth

And through idleness of the hands the house droppeth through.

Ecclesiastes 10 v18

For further information please contact: **Dr Joanne Curran,** Consarc Design Group, The Gas Office, 4 Cromac Quay, Ormeau Road, Belfast BT7 2JD T: 028 90 828400 E: Joanne.curran@consarc-design.co.uk

Stone eating lichen

The Giant's Causeway: myth and reality

DIFFERENCE BETWEEN REASON AND UNREASON

The Giant's Causeway is one of the geological wonders of this planet, formed from lava erupted some 60 million years ago and now marvellously sculpted by the weather and the sea. It is an iconic landscape and fully deserves its status as a World Heritage Site. A new Visitors' Centre is vital to help explain its history and significance but there have been demands from a minority group that the centre should include an explanation of the Causeway as not more than 5000 years old.

Giving in to these demands would be utterly wrong.

It was James Ussher, Archbishop of Armagh, who in the 1650s painstakingly worked out, by taking the Bible literally and following back the quoted generations, that the Earth was created in 4004 BC. He was one of the most learned men of his day and it is reasonable to assume that, had he lived today and had access to the wealth of contemporary scientific knowledge, he would have seen the Biblical texts in a very different light.

It is no attack on Christianity or indeed any other religion to say that the Earth and its rocks stretch back to ages far greater than those claimed by the young-Earth creationists. Current opinion based on overwhelming evidence from modern age-dating techniques, fossils and astronomy puts the age of the Earth at about 4.6 billion years.

The Giant's Causeway volcanic rocks have been dated to 60 million years before present. Young in Earth terms but still almost unimaginably ancient to a human perspective.

Even in Victorian times scientists and philosophers had realized that the Earth must be vastly older than the few thousands of years obtained from a literal interpretation of Old Testament chronology. They did this simply by using their observations and their powers of reason, by looking at the evidence in the landscape, just as anyone can do today. Beneath the Giant's Causeway rocks is the white rock called Chalk, formed in a sea teeming with marine life, now preserved as fossils. Above it are clays, again rich in plant and animal life, which can be accurately dated. These deposits and their ages now have been linked with rocks around the world. Today there can be no doubt about the general magnitude of time.

It must be added that most of the early scientists belonged to a faith and had little trouble reconciling it with the evidence they saw before them. Indeed, in an increasingly troubled world the moral lessons to be gained from the books of faith are difficult to deny. In 1615, Galileo wrote to the Grand Duchess Christina that ***the Bible teaches one how to go to Heaven, not how the Heavens go***.

The young-Earth creationists' view of Earth history is quite simply wrong. It is a manifest untruth. It is as wrong as saying that the Moon is made of green cheese or that the Earth is flat. We love the myth that Finn MacCool constructed the Giant's Causeway but everyone accepts that for what it is. Here we are not dealing with alternative views of the universe: we are dealing with the difference between reason and unreason.

We do not question the right of creationists to hold or expound their views. We do, however, profoundly disagree with any suggestion that creationist views should be given significant space in publicly funded museums, visitor centres, school science lessons or science textbooks.

Stratigraphy Commission of the Geological Society of London

Jan Zalasiewicz (Chair) (University of Leicester), Andrew Kerr (University of Cardiff), Mark Hounslow (Lancaster University), Colin Waters (secretary) (British Geological Survey), F. John Gregory (Petro-Strat Ltd; Natural History Museum, London), Tiffany L. Barry (Open University), Paul R. Bown (University College London), Patrick Brenchley (University of Liverpool), Angela L. Coe (Open University), John C.W. Cope (University of Cardiff), Robert Knox (British Geological Survey), Andrew Gale (University of Portsmouth), Philip Gibbard (University of Cambridge), John Marshall (University of Southampton), John Powell (British Geological Survey), Michael Oates (BG Group plc), Paul Pearson (University of Cardiff), Alan Smith (University of Cambridge), Philip Stone (British Geological Survey), Peter Rawson University of Hull), Mark Williams (University of Leicester) *and* Tony Bazley (Editor, Earth Science Ireland and not a member of the Commission)

Whats On

IRISH GEOLOGICAL ASSOCIATION
Summer 2008 www.geology.ie

Sat. 3 May	Field trip to Loughshinny, Co. Dublin, led by Dr. John Walsh (UCD). Basic structural geology, looking at spectacular folds and faults. *Meet: Loughshinny at 12.00 noon.*
Thur. 8 May	**Members' Night**. A social night. Bring along interesting rocks and fossils to show them off or to have them identified. There will be a couple of short talks. Food, tea, coffee, soft drinks, and perhaps a glass of wine, will be available. *Venue: Geological Survey of Ireland. Time: 8.00pm*
18th to 26th May	**Field trip to southern Poland.** For details see Newsletter and our website
w/e 21-22 June	**Joint IGA/CGA field trip to the Mullet Peninsula, Co. Mayo** led by Julian Menuge (UCD)

For further details about these and future events see Newsletter and website.
***Susan Pyne**, President*

Science and Fundamentalism

UNCOMFORTABLE BEDFELLOWS

Opinion piece by Tom Mason, Director Armagh Planetarium

Science and Religion can make uncomfortable bedfellows. Creationists, disagreeing with the scientific explanation of the natural world, argue that science also is a religion: nothing could be further from the truth. To mention just a few differences: (1) religious ideas and rituals are quite static, science changes on a daily basis; (2) religions all recognise a supreme being, science does not; (3) religions address how humans interact with each other and their role in society, evolutionary science describes our biological background and our place within the Animal Kingdom.

I have written this article to draw attention to what I perceive as a local shift towards irrationality. In my opinion, most people are eminently sensible and can easily differentiate between reason and logic and irrationality, recognising that science and religion are quite separate. Thus most religious people follow a coherent and reasonable belief system that provides them with a comforting knowledge and faith in their god: that is their absolute right. There remains, however, in the spectrum of both Christianity and Islam, fundamentalist minorities seeking the conversion of everyone to their belief systems, sometimes still advocating alarming violence to do so (the Inquisition and Jihad). I see this as a scary consequence of irrationality, and a stubborn lack of acceptance that others are equally entitled to hold diametrically opposing views to theirs.

In this article I specifically strongly contest the recent fundamentalist demand by Lisburn City Council. This is that local schools should provide an explanation of what plans they have to develop teaching material in relation to intelligent design (creationism in different clothes) and other theories of origin. It is an unreasonable request because it is founded on ignorance. As it affects organisations like mine, the Armagh Planetarium, I must state our position clearly. Not to challenge this narrow-minded world view is to risk losing the argument by default and it is a mistake to underestimate the single-minded determination of the creationist movement. I am pleased to note that several heads of Lisburn schools responded that it is the business of the City Council to govern us within their sphere of influence, and to leave the teaching and curriculum content to the professionals in those fields.

The Planetarium is a scientific organisation; we place before our audiences' scientific facts and try to explain them as best we can. At Christmas we also show *The Mystery of the Christmas Star* that explains scientifically what the Magi may have observed as they watched the skies. Obviously to do this we refer to the story of the birth of Jesus and try to pin down when this might have been - using not only the biblical accounts but also historical facts from other sources to corroborate and support the interpretation. This is how research science works.

I should explain that the relationships between creationists, creation science and intelligent design also have evolved, at least in their name. Their arguments and claims may have subtly changed but they remain creationist ideas dressed up in different clothes, an opinion which has been endorsed by the US courts, where a federal judge prevented a Pennsylvania school district from teaching "intelligent design" in a biology class, saying the concept is creationism in disguise. US-based creationists are a powerful force in the US, as polls show that around 66% of the US population professes to believe in the biblical account of Creation. I think that this is a powerful indictment of the US educational system. There is neither the time nor the space here to deal with all of the creationist arguments that are marshaled to disprove evolutionary science, so I will mention only a few.

Creationists insist that their beliefs should be given equal time in classrooms: an obvious counterclaim would be to seek equal time for the discussion of evolutionary science in churches. Teaching of creationism as part of science classes, even as an alternative, is foolish because creationism is not scientific. Moreover, which alternative creation stories ought to be left out? Why not take into account all of the other religious explanations of creation from around the world, and give them equal time also?

Complex eye of a 400 million year old trilobite

Intelligent Design is based on incredulity: it is stated that it is inconceivable that, for example, legs and arms could have originated naturally. Therefore, they must have been created by intelligent design (= a creator = god). You can substitute almost anything for the example I have used, the argument is the same. Eyes appear to be a current favourite, yet in the course of evolution eyes have evolved many times. Eye designs range from simple to complex and are found in trilobites, insects, flatworms, snails, scallops, spiders, scorpions, octopus and squid as well as the vertebrate eye. Maybe the designer liked variety as well as complexity.

The complexity of eye design (= creator) argument is fundamental to creationist reasoning. It is used especially to refute the possibility that life could have arisen abiogenically, and it is a cornerstone of the claims of intelligent designers. It is easily countered, as it is not reasonable to assume that things are impossible because you personally know nothing about the topic. Most people have a rudimentary knowledge of how electricity and internal combustion engines work, but their ignorance of the physics and engineering does not make it impossible for them to watch TV or drive their cars. This is an argument founded on ignorance. Likewise, until we knew how

infections were spread God was blamed for plagues like the Black Death. Now that we know more, the scientific explanation is that the bacterium *Yersinia pestis* is the real culprit. As our knowledge of the natural world grows, the "space" for the god of ignorance shrinks.

Another favourite creationist argument is that evolution is only a theory. In the scientific context this does not imply uncertainty. There is also a gravitational theory, and it is also under constant scrutiny, but gravity is an incontrovertible fact. Further facts are that the earliest forms of life on Earth appeared over three billion years ago. I have collected samples of these organisms in Africa (stromatolites) and published papers about them. The rest of the scientific community refers to this work and it is part of the general fabric of scientific knowledge. *Stromatolites are calcareous mounds built up of lime-secreting cyanobacteria and trapped sediment.* The story that we published about them in 1976 was based on the best science that we knew at that time. Further work has modified our ideas but has not changed the basic observational facts. What has changed is the interpretation, based on maturing knowledge contributed by other scientists. This is how science works. I have also collected trilobites in Utah, Newfoundland and Ireland. They demonstrate a continuum of change as these animals diversified with time. The trilobite fossils are facts. The interpretation of how they lived is based on observations of their structure and form, inferences drawn from other animals that make their living in the same way, and the nature of the sedimentary rock in which they are found.

Most of us are aware of the deadly influenza epidemic that killed millions after the First World War. You will also be aware that the flu virus changes rapidly (= mutates = evolves) and that the changes mean a new vaccine is needed each year. This is evolution in action. These are also scientific facts. Should we ignore this progress in our understanding and revert to treating diseases as if we still lived in the 15th century? You will also be aware of people being infected in hospitals by MRSA (Methicillin-Resistant Staphylococcus Aureus) bacteria that have evolved into antibiotic resistant strains. It is another example of evolution in action.

It is a sad fact that despite the benefits of education many still act as if they are living in the Dark Ages. Fundamentalism in any religious group is a dangerous aberration. It leads to a perversion of the messages that are common to all of the great world religions: compassion and empathy, loving one's neighbour and living in harmony with one's fellows. The god-given belief that you know better than others leads not only to intellectually impoverished intelligent designers but also to the aberrant psychology of jihadists and suicide bombers. They are two faces of the same coin, and the internal logic in both cases is seriously flawed. That is the elemental difference between science and fundamentalist religions, reason versus irrationality.

I also think that geologists have a special responsibility in this area. Much of what is challenged by the creationist viewpoint runs contrary to the science that we practice. I think that it is always better for someone who actually works with radiometric dating, or with fossils, or meteorites to refute the argument. I hope that this brief article may provide some food for thought.

(This article originally appeared in Armagh Planetarium's Astronotes in November 2007.)

For an exhaustive list of rebuttals of Creationist claims please see http://www.talkorigins.org/indexcc/

IYPE activities in the Cork Region

Bettie Higgs tells us:

The first International Year of Planet Earth public lecture in Ireland, "***Earth and Life: Interlocking Histories***", was held in University College Cork on January 17th. Cork Geological Association and the Department of Geology were the hosts.

Prof. Aubrey Manning, Emeritus Professor at the University of Edinburgh, gave a stunning lecture attended by an audience of 150 people. Prof. Manning was challenged with thought-provoking questions from the floor and gave well-considered personal opinions about the future of our planet. The discussion continued at a wine reception hosted by the Geology Department.

A walk along the beach at ***Graball Bay*** on Saturday February 9th organised by the Cork Geological Association and led by Dr. Bettie Higgs, was the next activity. The objective was to study the raised beach deposit overlying the superbly folded Devonian sandstones and mudstones. The 25 participants discussed the implications for past climatic events and searched for evidence of the age and composition of the deposit. The heavily haematised, though poorly cemented, raised beach deposit consists of rounded quartz grains and appears to contain no shells. A sample was taken for further investigation. The deposit is well exposed along the coast and is believed to correlate with the Courtmacsherry Raised Beach, which is seen at several localities around the southern coast of Ireland. Studies carried out in Co. Wexford have dated this raised beach deposit at 130,000 to 160,000 years BP. The walk was followed by the annual CGA lunch in Crosshaven Village.

The third event was a lecture entitled **"**Drilling into the memory of Earth" and is reported elsewhere in this issue.

Raised beach deposits overlying Devonian rocks – 342 million years between them!

Six Common Kinds of Rock from Ireland

***Betty Keyes,* currently working in a primary school in Tallaght, Dublin 24, tells the story**

The first set of rock samples arrived in our school before Christmas, when we were busy rehearsing for our Nativity Play and Carol Service, and were preparing for our Christmas tests. So they were left on a shelf in the little alcove that we lovingly call our Science Room, and Ian's book was left on the shelf beside them.

Towards the end of January, I rooted out the samples and proceeded to read the book, wondering if it would be at all useful for teaching the age group I work with, which is 8–12 years old. Here, I have to report that I have acquired many books on geology over the years, and have tried valiantly to read them… but this is the first one I have ever actually finished! And when it came to introducing the subject of geology to the children, Ian's advice about where *not* to begin was very sound. It was in keeping with what we generally try to do in primary school, which is to begin with the tangible and move on from there to the theory.

So, with this in mind, I started by letting the children handle the rock samples, feeling the weight and texture of each piece, and picking out characteristics such as colour variations and shiny bits. Indeed there was good subject integration involved, crossing over into English vocabulary and Maths, e.g. comparing size, shape and weight. Locating the source of each sample on the map of Ireland brought Geography into the mix as well. (Mary Hanifin would surely say "*Give those teachers a raise in pay*"!)

From there, the children became interested in how old the rocks were, and how they were formed all those years ago. Before I gave them the name 'sandstone', they were chuffed to have guessed that it was made of sand. Some insisted on calling the mudstone "muckstone", though! Then they wanted to know how the rocks came to be in the places they were collected from. As I am not a geologist, Ian's book was invaluable in helping me to explain. It is a very user-friendly book, written with the non-geologist in mind. The explanations about how the different types of rocks were formed are crystal clear, and the diagrams and illustrations in the book have been kept deliberately simple. The samples themselves have been colour-coded with spots of paint, an inspired idea as it would be very easy for people who are not geologists to get the samples mixed up.

Ian Sanders introducing rocks to a future geologist?

The children in my group also wanted to know how they were used in everyday life. Some children have granite worktops in their homes and others have seen sandstone pebbles used in patios and driveways. Even the play-sand they used in kindergarten is made from finely crushed sandstone. Reading from Ian's book, I was able to teach them how limestone is mixed with mudstone to make cement. Most of the children have seen cement powder and now they know where it comes from.

I was so impressed that I e-mailed Ian and asked him to send me a second set of samples so I could have one set for general use in the school and the other for use in my own classroom. He very kindly sent on the second set, which I am guarding jealously. When they arrived in the post, the school secretary asked if I was laying a new driveway!

I'd like to finish by stating that I heartily recommend this book for use in primary schools. I commend Ian for the tremendous work he has done to make the subject accessible to so many people. And I want him to know that now in our school, thanks to him, geology ROCKS!

Editor – this 'review says it all! Rock samples have gone to schools all around Ireland. Each set comprises six rocks (sizeable lumps) and a small 48-page booklet accompanies them. So far there are 5,000 rock sets 'out there'! A remarkable achievement and real 'labour of love' by Ian Sanders and his team at Trinity College, Dublin. It was on the 21st February at the College Museum that a formal celebration of the project was honoured by the presence of Minister Eamon Ryan, TD. This is Trinity's main contribution to International Year of Planet Earth and is certainly substantial.

Books and samples are freely available to schools on request to Dr Ian Sanders, Department of Geology, Trinity College, Dublin 2; Tel: +3531 896 1252; www.tcd.ie/Geology/outreach

WATERLOO ASSI, County Antrim

The value of site designations

The most important geological sites in Northern Ireland have been highlighted and documented through the Environment and Heritage Service's ***Earth Science Conservation Review*** (www.habitas.org.uk/escr). A significant number of these sites have now been designated as Areas of Special Scientific Interest. I am often asked what the purpose of designations are in the context of geological localities - many of these sites are certainly not as obviously vulnerable as some of our important biological sites but a range of real threats exist that can result in the geological interest being diminished or lost. Not least from development!

The transition from lighter coloured Triassic rocks to darker Jurassic mudstones

The oldest rocks at Waterloo; red Triassic mudstone shows through beach pebbles

Waterloo ASSI was designated in 1995; it is a well-known locality comprising an extensive coastal outcrop north of Larne, Co. Antrim. It is particularly important for the rocks and fossils of the Penarth Group of the Upper Triassic and the Lower Lias of the Jurassic. It has become a notable research site with a number of important discoveries (www.habitas.org.uk/larne/seadragon.html), novel interpretations (www.habitas.org.uk/larne/seismite.html) and recognition as a potential Global Stratotype Section and Point (GSSP) for the base of the Jurassic System (www.habitas.org.uk/larne/pot_gssp.html). It is well used as an excursion destination and has featured in a popular BBC television series on the natural world www.bbc.co.uk/northernireland/livingworld/naturalhistory/walk/index.shtml.

In addition to the main Penarth Group and Liassic sections, the site also provides outcrop of the Triassic Mercia Mudstone Group at its southern end while further north, the foreshore exhibits rocks of Cretaceous age. It is the most accessible locality for this rock series anywhere in Northern Ireland and, indeed, the Republic of Ireland where rocks of this age do not crop out on land.

Some 8 years ago a development proposal was submitted to the Planning Service in Northern Ireland. This was for a major marina with associated housing and retail facilities. Sited at the southern end of the ASSI, the development would encroach into the ASSI resulting in the loss of the Mercia Mudstones 'red beds' exposure. While these are widespread around the coast of Co. Antrim, it was felt by many that retaining them at Waterloo was important, enhancing the geodiversity of the site and hence its educational value.

In addition to the direct losses there was the potential of further impact to the site integrity through possible alteration to the wave-sediment regime due to construction of seawalls (unlikely here but this can lead to sediment accumulation which effectively buries part of the adjoining geology) and through the effect of the loading due to dumped stone (part of the development needs) causing distortion to the relatively soft Triassic mudstones.

While neither the development itself nor the possible consequential aspects noted above would impact on the most important elements of the site (which are further north), retention of the full geological series was thought to be of importance hence Environment and Heritage Service (a statutory consultee on planning matters) recommended that planning permission be refused.

Following many years of protracted discussion, Planning Service finally issued a refusal in November 2007 on the grounds that the development would have an adverse impact on the geological interest of the ASSI. Further reasons related to consequential impacts on public access along the promenade (the main means of accessing the geological features) and also the opinion that this section of coastline was inappropriate for this type of development. The latter is of importance as a high proportion of our coast hosts notable geology and may come under future threat as demand for marinas and housing complexes shows no sign of diminishing.

This is the first time that protection of a geological ASSI has been cited as a principle reason for refusing planning permission – a hopeful sign. The developers still have an opportunity to appeal this decision or may submit an amended proposal – any future developments will be reported here.

Ian Enlander, Earth Heritage, Environment and Heritage Service

Disturbed bedding in Penarth Group rocks, some think due to an asteroid impact

‘Virtual’ Gold Planning Enquiry

Schools Challenge Day held at W5, Belfast on 13th February

Schools Challenge Day, now in its third year so it has become an annual event, was held in W5 and was attended by 4 schools: Methodist College, Belfast, Victoria College, Belfast, Collegiate Grammar School, Enniskillen, and Sacred Heart Grammar School, Newry. Lower-sixth form students of geology, geography, citizenship, government and politics, and media studies took part in the challenge.

The event is designed to raise awareness, appreciation and understanding of Earth science among schools and the general public, encouraging students to understand how effective planning and management can benefit both society and natural environments. It took place at a time of renewed focus on the responsible use of the Earth’s resources. The exercise involved teamwork; time management; critical thinking; analytical; numerical; comprehensive; presentation and debating skills. The issue at the centre of the role-play event was the proposed development of a gold mine in an area of outstanding natural beauty in Northern Ireland.

The event focussed on the various planning; environmental; economical; political; geological; and social issues which surround a development of this type.

The day was structured around eight ‘workstations’; the Planning Service; the Environment and Heritage Service; a mineral exploration company; a district council chamber; a press room; a group of environmentalists; the general public and the GSNI.

The scene was set by a simulated news broadcast on the issue that concluded with the announcement of a public enquiry. Eight groups of 10 students were given tasks that were coordinated and guided by a facilitator. These tasks involved interaction, meetings and communications between the other workstations. The information gathered was used to formulate the case for or against the proposed development.

The pupils produced an excellent range of arguments for and against the development of a Gold Mine in Omagh. For the first time in three years the Public Enquiry favoured the proposed development.

The Schools Challenge gives an excellent opportunity for a group of students to experience a real life scenario linked to the Galantas Gold Corporation. It gave them an invaluable insight into the different agencies involved with the proposed extraction of a local resource. The pupils were very positive about the opportunity and thanks to W5, GSNI, DETI and Weber Shandwick for supporting and organising the event.

Further information about gold mining in Northern Ireland can be found on the website http://www.galantas.com/corporate/s/AboutUs.html

Karen Parks

DISCOVERING LIFE ON EARTH

Date: 21st February.
Occasion: IYPE Public Lecture.
Place: W5 Belfast
Speaker: Dr Richard Fortey, President of the Geological Society of London.

Richard Fortey is best known as a writer of relatively popular books on Earth science, particularly trilobites and ‘work behind the scenes’ in the Natural History Museum in London.

So, Trilobite Man, as he has been know, came to compete (in the crowd drawing sense) with Pat Cash, tennis player, who was appearing in the Masters tournament in the same building. The day before he had given the same lecture in Dublin, without such a distraction.

An audience of around 150 people was treated to a race through life on Earth. Starting with *really* ancient life, about which we now know so much more than even a decade ago. 3,000 billion years ago came the blue green bacteria, archaeobacteria that formed sediment-trapping mats making the recognised fossil mounds of *Stromatolites*. For

Man and the Dodo. Photo GSNi

more than two billion years tiny life forms just ‘ticked over’, then came the explosions of life diversity. Some quite large forms were moving about ocean floors around 700 to 600 my ago judging from the trace fossils in sediments. Then in the early Cambrian, 500 million years ago, animals developed hard parts and there are vast arrays of fossils now known, some even with their soft organs preserved.

Other extinction events happened, followed by explosions of species. Biodiversity highs, followed by biodiversity lows. Reasons? Strikes by extra-terrestrial missiles (comets or meteorites), volcanic activity, disease - and more - were discussed. Certainly we now know it is “***all far more complicated than we thought***”. Including Man’s evolution!

Are we causing the next mass extinction? The speaker thought so. The Dodo died out whilst under our custodianship. We must try not to reduce our biodiversity any further. Animals and plants are currently becoming extinct before they have even been recognised and described. We don’t want our knowledge of life to just be like the Dodo, a stuffed model with cygnet feathers, or in bottles in a Museum. We should want them out there living. *But can we stop what is happening and will we be the cause of our own extinction? The question was left hanging.*

ESI reporter

World-class data sets

Aircraft on survey over Newtownards, Co Down

Vital contribution to economy reported at major conference

***Mike Young**, Tellus Project Manager, gives us details*

The Geological Survey of Northern Ireland staged a major two-day conference in October to discuss the results of the Tellus project. 175 delegates and guests representing government, industry and academic organisations from the UK and Ireland attended the meeting, at W5 in the Odyssey Centre, Belfast.

The event was opened by ***DETI Minister Nigel Dodds*** who spoke of the vital contribution of natural resources to the economy and of the valuable role of the Tellus Project in promoting their development. "*Northern Ireland now has world-class geo-scientific datasets that will both encourage investment in resources exploitation and provide a basis for environmental management*", he said.

L to r: Gordon Best (NI Director, QPANI); Garth Earls (Director, GSNI); Dr Sally Montgomery (CEO, W5); Minister Nigel Dodds, MLA

New exhibition at W5

During the proceedings, the Minister opened a new permanent exhibit at W5 that illustrates the role of the quarry industry in the local economy. Samples of different rocks quarried from all parts of Northern Ireland are displayed and their use in various famous buildings illustrated. The exhibit was designed jointly by W5 and GSNI. It includes interactive access to the digital quarry database developed by the ***Quarry Products Association of Northern Ireland***, whose members supplied the rock samples.

Distinguished guests

Environment Minister Arlene Foster attended the evening reception, at which other guests included Prof Sir Keith O'Nions FRS, Director General of Science and Innovation at the Department of Innovation, Universities and Skills and former Head of the Department of Earth Sciences at Oxford. Sir Keith spoke of the importance of continual effort to ensure that databases such as produced by Tellus were widely disseminated and used. Derek Davis, Chairman, and Prof John Ludden, Executive Director, of the British Geological Survey (BGS) were also present, as well as senior representatives from Queen's University, government and industry. Distinguished visitors from the Republic of Ireland included Prof James Slevin, President of the Royal Irish Academy, and Dr Peadar McArdle, Director of the Geological Survey of Ireland.

TV presenter

In the opening session, Dr Iain Stewart, presenter of popular BBC-TV geology series such as 'Journeys from the Centre of the Earth' and 'Earth – the Power of the Planet', presented a gripping description of the critical impact of earth processes on human life, society and the economy. Prof John Ludden then reviewed the new strategy of the Natural Environment Research Council, emphasising the outward looking policy of focusing on research relating to the global environment and energy.

Over two days of technical, poster and workshop sessions, the delegates heard about the progress of numerous research projects that are already using the Tellus data, in the varied fields of natural resources and geothermal energy exploration, environmental monitoring, water resources, human health, agriculture, radioactivity and geostatistics.

Dr Iain Stewart

Surge of prospecting activity

The conference and Tellus results were widely reported in the Northern Ireland and Irish press, the Guardian and on the BBC's Today programme. Tellus datasets have already been licensed by several exploration companies and prompted a surge of prospecting activity. Consequently, more than half of Northern Ireland is now under mineral exploration licence or licence application. Several university departments are already using the data for research in various fields.

Conference presentations can be found on the project website http://www.bgs.ac.uk/gsni/tellus/conference/index.html

Prof Sir Keith O'Nions,FRS and Dr Mike Young

MOURNE MOUNTAINS ANOTHER POLITICAL FOOTBALL?

The Editor writes:

It is like the number 9 bus, wait an hour for one to come and then two come round the corner. After the Giant's Causeway 'affair', that the ES2k Chairman refers to elsewhere in this issue as an unseemly squabble and led to a ministerial resignation, comes the Mournes National Park proposal - and counter-proposal.

The plan to designate the Mournes as Northern Ireland's first national park is supported by several government bodies, including the Northern Ireland Tourist Board. We have had articles about it. Now it appears to have been 'trumped' by a more recent proposal for a ***transnational geopark***.

The transnational park would take in Dundalk, Newry, Banbridge, Monaghan, Newcastle and Kilkeel, about 50 square-miles. Geologically it would include the Ring of Gullion, the Cooley Mountains and the Mourne Mountains – certainly a geological entity wherever the county borders lie.

It would be good to see a rational debate about the economic and conservation pros and cons of the proposal. The first annual meeting of a group set up to oppose the designation of a national park did not make a good start. What was said? *Don't allow the politicians, particularly Sinn Fein and the SDLP, 'to lead them down the road of a cross-border park in the pretence this is an all-Ireland issue'*. So no rational debate here, back to a political football.

The Mournes and the wider area are still a long way from designation as any sort of 'special' park. So this is the time to set out the advantages or disadvantages. This is the time to ensure that the rights and aspirations of all the interested parties are protected. Can we look around other parts of Ireland and say formal conservation of our landscapes is unnecessary because we can trust the business people and planners to get it right? Would this area get 'geopark' status even if it applied for it? A geo-park by definition has to involve development of the local economy by working closely with local businesses, including farming, quarrying and tourism interests. It is not the same as a national park, which is much more about conservation. Yet visit the Snowdonia National Park, the Peak District National Park and parts of the Scottish Highlands and it is hard not to be impressed by the way the landscape is relatively unspoilt. No rash of modern bungalows that is the scourge of parts of County Donegal.

One thing is certain, the Mourne Mountains, the Ring of Gullion and the Cooley Mountains are worth considering

for special status. **They are special**. Too special to be used as a political football!

ES2k must watch the progress of these plans and be involved. It must do its best to ensure that our voice is heard.

Review

FOSSIL REVISION CARDS

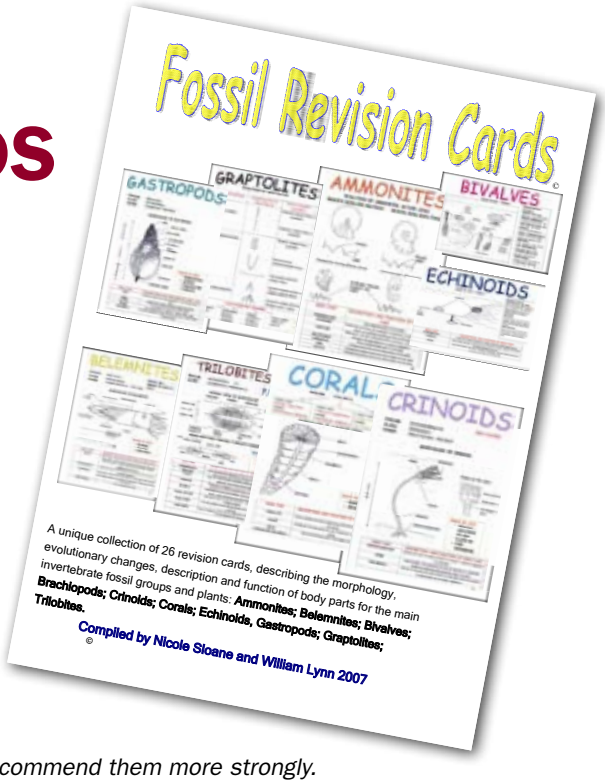
Compiled by Nicole Sloane & William Lynn 2007

Why didn't cards like this exist when I was at school and college? Twenty six cards describe, mostly using sketches and tables, all the main invertebrate fossil groups and plants: Ammonites, Belemnites, Bivalves, Brachiopods, Crinoids, Corals, Echinoids, Gastropods, Graptolites and Trilobites. They label all the body parts, show how they worked, describe evolutionary changes, the environment in which they lived and whether they are useful 'zonal' fossils.

The cards, each about 9 x 14.5 cm, have a semi-gloss finish and fit neatly into a clear plastic packet. The authors are very highly respected geology/geography teachers who know how to present complicated information in a way students understand – their exam results prove the fact. They have succeeded completely. All the key facts are given and the presentation is attractive.

Is it wrong to 'hand-feed' students in this way? I don't think so. What is more important is giving the facts in an easy way so people can then take the next step – questioning the past of our planet and what it means for us today, be that in terms of climate change, finding resources or evolution.

The word 'people' is used deliberately because these cards will be useful for amateur geologists. They will give them all they really need to know before they go out fossil hunting.



I couldn't recommend them more strongly.

Teachers, students and amateur geologists will find them an excellent aide-memoire. They are only available from the authors. Price £10 (€15) for each complete pack. Contact Nicole Sloane (07743418162) or William Lynn (07771608084), or email: roc_chic_nic@hotmail.com or wlynn_geology@hotmail.com

Tony Bazley

The Irish Gemmological Society

The inaugural workshop and lecture of The Irish Gemmological Society took place recently in the Siobhain McKenna Theatre in National University of Ireland Galway (NUIG). The guest lecturer for this event was the pioneering Glasgow gemmologist Mr. Allen Hodgkinson, FGA, and was attended by several prominent local gem specialists, as well as a large attendance of gemmology and earth science students from NUIG's Earth and Ocean Sciences Department. The lecture and workshop focused on emeralds, both natural and synthetic. Allen Hodginson's teaching collection, which was the core material for the afternoon workshop, amounted to over a hundred emerald samples –indeed the largest teaching collection of emeralds available.

The society, being spearheaded by Dr Anne Marie Gilmore, (research gemmologist at NUIG) has come about through the Diploma in Gemmology course being run by Dr Martin Feely and Mr Padraic Lavin at NUIG. The two-year course began in September 2004, and to date has nineteen graduates, with another fourteen set to complete in May 2008. Students on the course range from experienced jewellers to interested novices, and it is the only course of its type available through an Irish university. Registration for next September will be underway from May 2008. A significant cohort has already informally enrolled for the course. Further details of the society are available on www.irishgemmologicalsociety.com.

Mr Allen Hodgkinson FGA (Guest Lecturer). Dr Anne Marie Gilmore (Chairperson, Irish Gemmolocical Society). Dr Martin Feely (Head of Course, Diploma In Gemmology. NUIG). Mrs Charlotte Hodgkinson, and Mr Padraic Lavin FGA (Senior Gemmologist, Diploma In Gemmology. NUIG). At The Inaugural Gemmology Lecture Of The Irish Gemmological Society In The Siobhain Mckenna Theatre. NUIG On Wednesday October 3rd. 2007.

TOP GEOLOGY STUDENTS & DYNAMIC COASTS

Methodist College, Belfast

Geography and geology students listened to an excellent talk by an ex-pupil of Methodist College just before Christmas. The subject was the dynamic nature of coasts with the focus on three local areas and many global examples.

L to r: Prof Andrew Cooper; David Pinkerton; Philip Todd; Karen Parks

Andrew Cooper, Professor of Coastal Studies in the School of Environmental Sciences at the University of Ulster, was the speaker. It proved, as expected, ideal for A Level and GCSE students because they have to study coastal management as part of their syllabus.

For three students who have now moved on to college life it was an especially memorable occasion. Last year, they came top of all the A Level students in Northern Ireland (OCR Board). The prizes are sponsored by Earth Science 2000 (ES2k) who wishes them all well in their future careers. They have made a fine start.

Professor Cooper made the presentations. 1st prize went to Philip Todd, 2nd prize to Graham Richardson and 3rd prize to David Pinkerton. As well as taking the top places here, they were all within the top 25 in the UK (OCR Examination Board).

Karen Parks

Billy Loughlin (1952 – 2007)

Irish remote senser, field geologist and mineral explorer

Graduating from Queen's Belfast in 1973, Billy joined Noranda (now incorporated into Xstrata) exploring for base metals in the Irish midlands. He joined the Zambia Geological Survey in 1977 and developed as a fine and resourceful bush geologist. In 1982, he was appointed to the Hunting Geology and Geophysics Limited team creating a mineral inventory of Mozambique, and then projects in Somalia and Saudi.

Billy returned to the UK, where he developed expert skills in remote sensing, especially using spectral properties of alteration minerals. He joined the team running the UK National Remote Sensing Centre. In 1988, he moved to the western USA to explore for gold and base metals. In 1990, Billy set up Geological Consultants (Ireland) Limited based in Derrygonelly, and was off exploring for gold in Ghana, notably for Santa Fe Mining. He became a representative of the international Geological Remote Sensing Group.

In late 1996, he joined Mark Parker to establish Twigg Resources Limited, now African Eagle Resources, an AIM-listed exploration company capitalised at £30 million. He forged field teams in Zambia and Tanzania. After stepping down as a Director in 2001, Billy continued image analysis and fieldwork in Africa.

He worked throughout Ireland in the field, notably for Glencar, continued to travel overseas, notably to Australia, and worked in Papua New Guinea for the British Geological Survey in 2003. He was increasingly happy fishing (he was an accomplished trout fly-fisherman) or following traditional Irish music and helping his father's picture framing business.

He is remembered for taking on the difficult jobs with enthusiasm and energy, being fun to work with, encouraging and welcoming, especially to those in need.

We are deeply saddened that Billy Loughlin died suddenly on 28 September 2007 at home in Derrygonelly, Co Fermanagh and our thoughts are with his wife Lorraine, Colm and Róisín.

Geoff Lawrence

Earth Science Ireland sometimes gives accounts of the lives of people who have, sadly, recently left us. These people are friends of Ireland, earth science and those they knew. Their stories can be an inspiration to young people. This is why we give them, as well as being a tribute to their memory.

GIVE OR TAKE 10 MILLION YEARS

Changing our understanding of Planet Earth's history

Dan Condon, NERC Isotope Geosciences Laboratory, BGS, Keyworth, England discusses ***Earthtime***.

For geologists, it's all about timing. 'Rough' estimates of age are all very well but questions are now being asked that need more accuracy. Could the cause of animal extinctions in the past tell us something that might help the future survival of the Human race? Can we learn why past climates have varied and is there a link with the changing carbon dioxide levels that so worry us today?

Volcanic ash bands (white) in late Cretaceous, Denver International Airport. Photo: Kirk Johnson

Light and dark couplets reflect 23,000-year precession cycles, Pliocene, Greece. Photo: Frits Hilgen

More accurately quantifying geological time is central to understanding the Earth system and that is what ***Earthtime*** is all about.

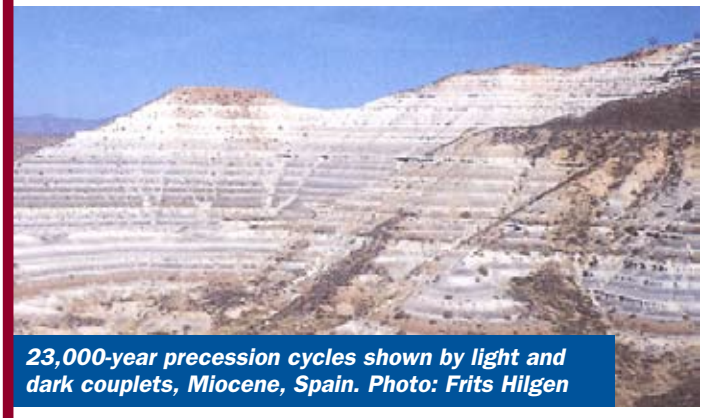
Knowing the age of certain rocks, be it a thick accumulation of volcanic lava like the Antrim basalts or an extinction event like the demise of the dinosaurs, allows us to say something about the cause. The dinosaurs are a good example. Although many scientists now believe birds are surviving relatives of the dinosaurs, all others died out '*about*' 66 million years ago. At '*about*' the same time a large asteroid struck what is now the Gulf of Mexico. At '*about*' the same time there were a series of huge volcanic eruptions in India. Both are viable kill mechanisms but was it one, both or none? Knowing they are '*about*' the same age is not good enough. To understand the cause of the extinction we need to know the sequence of events as precisely as possible.

Geologists now possess an impressive toolbox for quantifying geological time, ranging from radioisotopic dating of minerals and rocks, to the astronomical dating of cyclically deposited sedimentary rocks – the Earth's tilt and position relative to the sun, which varies periodically, is linked to sedimentary layers deep beneath our feet.

Advances in mass spectrometry, an analytical technique used to determine the amount of a given isotope such as Uranium 238 or its daughter product Lead 206 means we can date some rocks, for example, volcanic ash, with a precision of 0.1 percent or better. At 50 million years this is an error of just plus or minus 50,000 years. These techniques can be used on rocks of nearly any age, from a few thousand years to some billions of years old.

Astronomical dating, on the other hand, is based on recognising successive cyclically deposited sediments, which often reflect climate oscillations that depend on where the Earth is in its orbital cycle. We can compare the sedimentary deposits to mathematical models of the solar system for at least the last 100 million years. We know exactly the Earth's position and orientation in the solar system at any given period of time. These parameters influence Earth's climate and are reflected in the sedimentary record. Those repeated bands of rock you see so commonly when looking at a quarry or cliff face are examples. For cyclical successions younger than about 23 million years (in Ireland the Lough Neagh Clays are an example) the models work very well. As we go further back in time the uncertainty in the models increases. The most useful cycle occurs about every 405,000 years and is related to the eccentricity in the Earth's orbit around the sun. This cycle is very stable. If a researcher can recognise it in the rock record it can provide a relative sense of time. However, if we can date such successions using radioisotopic techniques, the cyclicity can be pinned down and used to tell time with unprecedented precision.

Pliocene rocks, Sicily, showing precession, obliquity and eccentricity related patterns in deep marine carbonate cycles. Photo: Frits Hilgen



23,000-year precession cycles shown by light and dark couplets, Miocene, Spain. Photo: Frits Hilgen

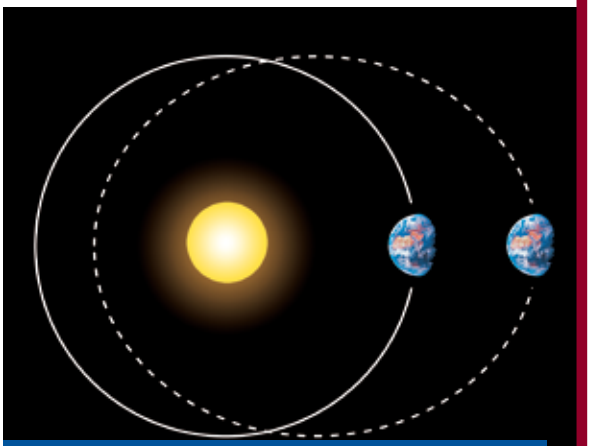
Combined, these techniques offer the potential for accurately dating many different types of geological records, from seafloor records collected during ocean drilling expeditions to sediments eroded from large mountain chains such as the Himalayas.... *but there is a catch* because, although you wouldn't necessarily know it from the literature, whilst spectrometers reproduce the

same or similar dates, the accuracy of these dates is still an issue.

Laboratories don't all give the same results from the same sample

The accuracy of radioisotopic dating depends on both our ability to determine the ratio of parent isotope to daughter isotope and how well we know the rate of decay for these radioactive particles, which depends on the decay constant. For Uranium-Lead decay these constants are known to a little over 0.1 percent. For others, however, like the decay of Potassium to Argon the uncertainty approaches 1 percent. Using the two methods on the same sample shows a systematic bias, with the Uranium-Lead dates always older by 0.5 to 1 percent. *So which is correct?* It all becomes cloudier when interlaboratory effects are tested. The same sample should give the same date from all laboratories but they don't. Sometimes the differences are bigger than the precision of the measurements.

Earthtime is an initiative to sort this out. It is an international, community-based, effort with more than 200 participants in over 30 countries. It is not just to develop tools for high-precision dating but it is about a philosophical change in the way we tackle Earth-scale projects. The bottom line is we have to do a better job of working together as an international community. Stratigraphers, palaeontologists, climate modellers and many others, not just exchanging data but also *really* working together. It means laboratories must share expertise and collaborate, standardising techniques and results.



Earth's orbit moves from circular to elliptical on 100,000 year and 405,000 year cycles

In the next few years, we plan an intensive effort focussing on intercalibrating different chronometers so they can be integrated without losing accuracy.

Where will we start? Where better than the extinction of the dinosaurs. We hope this will demonstrate that we can actually do it. This geological time slice is an interval that has a diverse geological record, which means we can apply all our techniques and compare results directly. It will also be of considerable public interest because everyone is fascinated to know, once and for all, why the dinosaurs became extinct. Then, we can move to improving the accuracy of longer time scales. Although **Earthtime** focuses on Earth's history, the constraints it provides will be critical for verifying global climate models used to predict future climate.

Based on an article from Planet Earth, the magazine of the Natural Environment Research Council, with thanks

Cunningham Awards hit the mark again

The Geological Survey of Ireland held another enormously successful awards ceremony last December. It seemed more like a pre-Christmas office party, which I guess it partly was. Invited guests were lucky to be part of such a happy occasion.

Running the show with his easy style of patter was the Director, Dr Peadar McArdle. It started with the ***Du Noyer Awards for Photography***, the exhibition in the library showing how very high the standard of entry was this year. Also, the organisers seem to have managed to get more entries of photographs of Irish geology rather than the swamping by overseas (holiday?) photographs of some previous years.

Two ladies took first and second prizes, ***Grainne Baxter*** and ***Judith Boyle*** respectively. Third was ES2k's officer and author David Kirk. Excuse us for only showing David receiving his prize. It shows bias but he does do sterling work for us!

Then came the Mark Cunningham Awards. It is always a pleasure to see the Cunningham family at this event and presenting the prizes. Mark Cunningham [1908 –1980] was a past Assistant Director of the GSI.

The two College awards for theses on areas of classic Irish geology went to Edward Lynch of NUI Galway, supervised by Dr Martin Feely, who mapped around Ardara in County Donegal, and Niamh O'Sullivan of Trinity College Dublin, supervisor Professor John Graham, who mapped in west Cork.

There were other awards but we especially noted that the GSI Staff Award went to Sarah Gatley, now a member of the ES2k committee. It is good to see the area of geological conservation coming to the fore and we congratulate Sarah on making such an impact in this role in a relatively short time.

Du Noyer photographic competition; David Kirk collects his prize from Susan Pyne and Peadar McArdle

TRUST IN THE ENVIRONMENT

Andrew Galwey debates the question

Crowding together

"Where will we go today?" A difficult question…so many wonderful places to visit! To the coast or to the country, outdoors or indoors…? Then the other concerns, "Will it rain?", "We must be back in time to see Granda", and "Jen gets carsick if we go too far"… Often the result is that preferred visits are not too far from home, particularly if there is an advertised diversion that will entertain at least some of the family. Consequently, on fine summer holiday weekends, we find the popular places of recreation filled to capacity while other equally appealing venues attract many fewer visitors. Also, it is noticeable that in the most crowded parks people tend to stay together: around restaurants, ice-cream vans and souvenir shops, even when a short walk beyond these 'services' brings a sharp drop in visitor densities.

This tendency to congregate must be taken into account by those that manage our leisure activities. Not that any of us like to think of being managed when off work or out of school. This, however, ignores the truth that increases in our personal freedom, from shorter working hours and increased mobility, means that most of us have more leisure time.

Mount Stewart House, Co Down

Nature under pressure

The ideal picture of relaxation on a beach or woodland is all too often replaced by reality. Leisure developments like holiday homes, caravan parks, refreshment outlets and 'amusements' that can degrade a former 'beauty spot' beyond all recognition.

Almost all the land that we inhabit has been modified by centuries of use by farmers, the building of towns and houses, the planting of conifer forests and, of course, roads. Nature is under pressure. But opinions differ about the degree to which we should protect our environment. The meaning of the word 'natural' varies widely for different people and, consequently, there are different opinions about every aspect of how we should, could, might, ought conserve our environment. Who should do this and how?

Running out of space

Throughout 'our' Planet, the pressures of civilization, whereby people seek to increase their standard of living, and acquire personal space, results in a progressive contraction of the area available to natural systems. Increasingly land is being used for the cultivation of food or being built over. The attitude seems to be to forget the other animals and plants that live on the same earth. Land is regarded as a commodity to be exploited for our exclusive use. This may be a convenient and comfortable attitude but the survival of our civilization remains critically dependent on a constant natural environment. Pollution and the potential it has for wiping out mankind is a serious worry. The human race has reached a size where resources are being overwhelmed: we are running out of space.

An answer?

Do the respective national trusts on our island, The National Trust and An Taisce, provide an answer? Many people think of them as 'Big Houses': the well-known mansions, castles and gardens, most built before 1800, such as Mount Stewart in County Down and Kanturk Castle in County Cork. Thanks to the trusts we can now visit and view these magnificent buildings. When seeing the former luxury enjoyed by a privileged few, we cannot forget the 'Master-Servant' hierarchy. Those who served had to work hard for long hours to sustain the comforts of their employers. Washing machines were people!

Events

Against this backdrop the trusts organise events for people of all ages; such as 'fun days', 'medieval jousting'

Kanturk Castle, Co Cork

and musical concerts of jazz or opera. Gardening is always popular. Visitors are free to walk in the well-tended grounds and enjoy the scented, colourful blooms. It is worth remembering though, that the impressive flower shows on display are essentially human creations. Spectacular plants are often artificially cultivated, having only the most distant relationship with any natural forebears and skilfully displayed in designed (but unnatural) patterns. Show gardens have little in common with natural flowers that are now in retreat as insensitive land management advances.

Largest landowner

The National Trust in Northern Ireland is the largest private landowner, managing 40 square miles of scenic countryside and 120 miles of coastline. This land is protected and selected to include areas in which animals and plants, now rare or under threat, can continue to thrive. Critically this means the landscape and geology on which they live must be conserved. It is in these places that anyone interested in plants, animals and, of course, birds can still observe some rare native species. Areas of truly natural countryside are becoming increasingly scarce and some will only survive if shielded from the pervasive consequences of human activities. This does not mean *'no farming'* but where

farming is appropriate it means using the land sustainably.

Top attraction is rock

The best known coastal attraction in Ireland is probably the Giants Causeway, designated a World Heritage Site in 1986. Around half a million visitors, many from overseas, visit it every year. The impressive array of naturally shaped rocks is 'geology at its most impressive'. How important it is that it is protected from unsympathetic and inappropriate development.

Difficult times ahead

Here, it has only been possible to touch briefly on a few aspects of the complicated problems that confront our civilization, some of which still remain imperfectly and incompletely understood. Debates, disagreements and difficulties about how we should plan the future for ourselves and for later generations will undoubtedly continue. What is certain is that Earth science, with organisations like the National Trust and An Taisce, will play an increasing role in helping the decision makers reach conclusions about how to sustain this beautiful island.

Earth scientists, Police & Popular Crime Writers

Good Showing at Soil forensic International Conference, Edinburgh, 2007

Report by Alastair Ruffell (QUB) & Lorna Dawson (Macaulay Institute, Aberdeen)

A successful and high profile meeting on soil forensic applications took place from 30th October to 1st November 2007, at the Edinburgh Conference Centre. This followed the first meeting in Perth (Australia) in 2006. A third conference is likely to be held in California in 2009. There was a wide range of participants attending, from over 15 nations - comprising more than 75 researchers, over 40 police or forensic practitioners, and 20 students. The conference focussed on current, new and developing approaches in soil forensic analysis and their potential application to investigative casework. Presentations included examples from environmental and criminal casework, as well as applications to human health, environmental protection and international terrorism. Topics for discussion in sessions included: geoforensics, geostatistics, databases and GIS, biological and chemical analytical diagnostics, forensic taphonomy, and communications and advocacy.

Anna Prieur (RGU, Aberdeen), Laurance Donnelley (Chair of the Geological Society Forensic Geology Group), Victoria Eaglesham (RGU, Aberdeen), and Antoinette Keaney (Queen's University Belfast) between Anna and Victoria's posters.

Macaulay Conference organisers David Miller and Lorna Dawson dig for clues with best selling crime author, Ian Rankin.

Belfast contributors featured highly, with talks from Dr Wolfram Meier-Augenstein (Engineering, QUB); Dr Crawford Jordan (DARDNI), Dr Jennifer McKinley (Geography, QUB) and Ms Antoinette Keaney (Geography, QUB), photograph below.

Public awareness

Due to the importance of raising public awareness and understanding of science, the conference tried to appeal to a wide range of audiences, and featured a public lecture by Prof James Robertson, Forensic Laboratories of the Australian Federal Police, on "Digging for clues. How soil is helping to solve crimes".

There was also an excellent conference dinner and soiree held in Our Dynamic Earth, for all delegates, mixing with 15 invited authors of fictional crime, in recognition of the popularity of this genre of writing, and its role in communicating messages about the importance of forensic science. One author has already drafted material for a book in which soils are an element of the story.

Conference media coverage included: BBC Scotland TV, ITV, BBC World Service, Radio 5Live (live and pre-recorded), Radio Scotland (live), Sunday Herald, The Herald, The Scotsman, The Times, Edinburgh Evening News, Press and Journal, Holyrood Magazine and Police Professional. A summary of the conference can be seen at the conference web site: http://www.soilforensicsinternational.org/ and at http://www.macaulay.ac.uk/news/broadcastmedia/index.php#item20071108

ROBIN REID - Palaeontologist

Robin Reid

Expert on the Chalk of NE Ireland and Dinosaur bone histology; great teacher and well-liked Prima Donna.

Another facet of the Geology Department at Queen's University, Belfast closed down with the passing of Robin (Robert Edward Hay) Reid on 28th November 2007.

Holding Stigmaria, a fossilised root of a giant plant.

Robin joined the staff of the Department as assistant lecturer in 1954 and for 37 years, as lecturer in 1955 and senior lecturer in 1967, he was the chief palaeontologist. In 1991 he returned to his family home in Chesham Bois (Buckinghamshire) making all too few return visits, though very memorable ones, to Belfast.

He was born in 1924 and after leaving school (Merchant Taylor's Northwood) went to study medicine but broke his course to join the Royal Air Force, becoming a navigator. On being demobbed he dropped medicine to take up geology at King's College, London where he gained a 1st Class BSc degree. He went on to do research but any later query about an unfinished doctorate (funded by a government scholarship) met with the same response –'*he wasn't going to oblige a Labour government by completing his*'. But Robin needed no string of letters after his name; his scholarship shone through every aspect of his work, illuminating every lecture, practical or field excursion. His zeal inspired all who came under his spell, nor was it limited to staff and students in the Department but was freely offered to all who contacted him. Members of the Belfast Geologists' Society will always remember the many field trips he led over the Cretaceous rocks of NE Ireland, the supporting winter lectures, and the advice he offered the Society as a long-term committee member (President in 1963/4 and 1969/70).

Meticulous, almost to a fault, I found him one evening as a visitor to my home testing out, at length, a new portable typewriter I had just acquired and was constrained to remark, "what the devil are you doing Robin, writing a paper?" "No" came the reply "just an opening sentence I have had in mind for some time". I recognised the mental process and left him to it; but not all who asked for his help knew of this trait in his character. The old Prof, J.K. Charlesworth, asked him for a contribution to one of his books and then rephrased it into what Robin told him to his face was a "garbled account". It prompted the Prof to enquire, next time he visited his old department "who is this *Prima Donna* you have on staff?" And *Prima Donna* he was and *Prima Donna* he remained.

This attention to detail surfaced on one occasion when he and I were introducing 2nd Year students to plane-table mapping at Coal Pit Bay. Robin expressed his dissatisfaction with the manner in which they had measured the baseline across the bay. So the exercise had to be repeated with Robin taking the lead and a student following at the other end of the tape. He left one wooden marker peg in the sand at the centre of the bay and moved on. But the encroaching tide paid as little heed to his plans as it did to King Canute. The first ripple lifted the peg and each succeeding ripple tossed it to and fro over the sand to the quiet amusement of everyone watching. The student holding the tape, however, showed great presence of mind and stuck it firmly back into the sand just before Robin, who had been counting his paces, turned to witness the correct procedure with the tape. The two measurements were too close to argue about!

Robin in typically flamboyant field attire

His abiding interest in the early years was in fossil sponges, the hexactinellida of the Cretaceous rocks of NE Ireland, but soon expanded into the stratigraphy and fauna of the system. H.E. Wilson, in his Regional Geology of Northern Ireland (1972) pays tribute to this work and Robin's research student T.P.Fletcher published in 1977 a very detailed lithostratigraphy of the Ulster White Limestone, which owed much to his supervisor's inspiration.

This interest no doubt prompted him to lead Honours field trips along the south coast of England to study the Jurassic and Cretaceous rocks; excursions which all his students, and indeed all members of staff who were privileged to accompany him, will remember all their lives. The department's chief technician, Billy McKaig, was his minibus driver on such occasions and whenever student numbers required a second vehicle I had no hesitation in volunteering.

Robin's custom on arriving at Lulworth Cove after a long drive down from Scotland was to refresh his students at a local bar. They, of course, returned the hospitality and on one occasion chose to do so at a luncheon stop where rough cider, scrumpy, was on tap. That

afternoon saw him demonstrating a very detailed cliff section with the words, “the sand horizon you can see at the base of the cliff is the Atherfield Clay”, a short pause followed by an abject apology offered in Robin’s public school voice, “Oh, I am dreadfully sorry you chaps, I seem to have dined a little too freely”. The next slip wasn’t long coming and no polite apology this time “you b.....s filled me up”. He worked his way up to the top of the section and then, to everyone’s surprise and dismay he returned to the bottom and started on the palaeontological succession! Thorough, even in his cups, and thoroughness was the hallmark of all his work.

Want to read some of Robin’s work? These will give you a start:

Reid, R.E.H. 1973. The chalk sea. *Irish Naturalist Journal* 17, 357-375.

Reid, R.E.H. 1993. Dinosaur blood cells rediscovered. *Nature* 366, 24.

In later years his research entailed a study of bone structure in dinosaurs. Members of the Belfast Geologists’ Society will remember a winter’s (78/79) lecture ‘Warm or Cold’ and this topic he pursued throughout his retirement. Research was somewhat hampered by the British Museum’s refusal to loan material from its collections to a private address, though he had an honorary research fellowship allowing him to work on the premises. Also by the loss of access to collections moved from the Utah Department of State History to the University of Utah and the Brigham Young University. The latter encouraged him to publish a report on their material in 1996, as complete an account of dinosaurian bone histology as existed at that time. In the following year he saw published two chapters on a similar topic, one in the Academic Press ‘Encyclopaedia of Dinosaurs’ and the other in the Indiana University Press ‘The Complete Dinosaur’.

Both these chapters were updated in later years and consideration given to further work on *Allosaurus*, even to a book on that topic.

So in his retirement he became a world authority on dinosaurian bone structure and to judge from his personal letters a most contentious one! A *Prima Donna* to the end.

Dr Jack Preston

Allosaurus

WHAT’S ON

Belfast Geologists’ Society

Members of Belfast Geologists’ Society are dusting off their boots and hammers and looking forward to another summer of enjoyable (and sometimes challenging!) field trips.

Although details and dates have not been finalised at time of going to Press (but see note at end) field trip programme organiser Dr Philip Doughty has once again come up with an eclectic range of events representative of both ‘pure’ and applied geology.

The ’long week-end’ Presidential excursion this year will be to the geologically (and botanically) fascinating ‘karst and caves’ Burren area of Co Clare at the end of May. In June members will visit Tyrone Brick to see how local clay is extracted and turned into building material and later in the summer they will see further examples of geology in action when they explore past industrial sites around Strangford Lough and their geological context.

In July and August field trips (dates to be confirmed) give members the opportunity to explore (and understand!) the Carboniferous formations around Kesh in Co Fermanagh and also the geological complexities of the Carlingford Mountains.

The Society has just finished its winter lecture series, which proved very stimulating and drew large audiences for every event.

Archaeology guru Richard Warner opened the series with a talk on the origins of ancient Irish gold and this was followed by an account of latest findings in coastal evolution studies by Professor Andrew Cooper from the University of Ulster. In December the annual Harold Wilson Memorial Lecture was delivered by the esteemed geo-historian Gordon Harries Davies, Professor Emeritus of Trinity College, Dublin, who recounted the important contribution that Irish geologists had made during the 200 years of the Geological Society of London. The spotlight was on the Mournes for two events, a scenic ‘virtual field trip’ by BGS President David Kirk and an explanation of evidence indicating a radically different process for the emplacement of the Mourne granites by Dr Carl Stevenson from the University of Birmingham. The series ended with a ‘trip’ to see the fish and early mammals of the Eocene in Wyoming by Dr John Nudds from Manchester University.

Next October will see the start of the Society’s next series, which promises as always to cover a wide range of interesting and informative subjects. Again these will be held in the Minor Hall at St Bartholemew’s Church on the Stranmillis Road in Belfast starting at 7.30 pm (with refreshments from 7 pm). They are usually held on the third Monday of each month. Anyone with an interest in geology is welcome.

Full details of this summer’s field trip programme and the winter lecture series can be had from Society Secretary Peter Millar – Belfast 90642886 or peter.millar@nireland.com.

The Island of Copper - Cyprus

Ian Forsythe of the Belfast Geologists' Society describes a 'specialist' holiday.

Societies often consider overseas trips for their members but need quite a number to get the economics right. Sometimes they must join up with other groups with similar interests. Are these 'specialist' holidays likely to take off as a way for amateurs to visit exotic geological regions of the world?

Easter last year a group from Belfast - mostly from the Belfast Naturalists' Field Club - joined in an Archaeological and Botanical Study Tour of the island of Cyprus. One day was devoted to the Troodos Mountains, of particular interest to the geologists in the party.

Ophiolite locality near Pano Amiandos

Cyprus - the very name has its origins in geology. It is a place famous in antiquity for its copper resources. The word 'copper' coming from the Greek name for the island, *Kupros*.

The island has two mountain ranges. The narrow, mostly limestone, Kyrenia Range in the north and the Troodos Mountains to the south. Between is the central plain (Mesaoria) with the capital city, Nicosia. The Troodos Mountains rise to 1951 metres at Mount Olympus. They have played a central role in our modern understanding of plate tectonics and the Troodos Ophiolites are now considered classic rocks.

Some 90 million years ago the Troodos Ophiolite was formed at the bottom of an ancient ocean called Tethys, in what is now probably the region of today's Red Sea. The uplift of Troodos above sea level began some 15 million years ago and that was the beginning of the creation of a new island, Cyprus.

World-class example

The uplift was due to the collision of the African continental plate with the Eurasian plate and the pushing downwards (subduction) of the first beneath the latter. This threw up the oceanic crust and the underlying mantle rocks, emplacing them within continental crust. So there are, thrown up from about 8,000 metres below sea level and now exposed more than 2,000 metres above sea level, sheet-like rocks (ophiolites) that formed by a process of sea-floor spreading. Sequences similar to those that today are forming deep below the middle of the spreading Atlantic and Pacific oceans. *For this, the Troodos Ophiolite is probably one of the most studied rock complexes in the world.*

Of considerable significance is that due to uplift and erosion the sequence of rocks on the surface has been reversed from its position in the oceanic crust. What were the deepest rocks from the mantle, including the ultramafic (very rich in olivine) igneous rock harzburgite, appear on the highest summits and the shallowest rocks (pillow lavas of the ocean floor where many of the copper deposits are found) appear in the foothills of the Troodos.

Nature trails

Mount Olympus is inaccessible due to military installations but tourists, mainly because of a good road system, can visit the other high points of the Troodos Range. In the small resort of Troodos there is a visitor centre with good exhibitions of local geology and botany.

From Troodos it is possible to follow many nature trails that are good for geological exploration. The one our group explored was the Kaledonia Trail, about 3 km long. Starting from near Troodos at 1600 metres we descended to 1200 metres close to the resort of Platres. Rocks seen included gabbro and wehrlite. It is the massive gabbroic rock that forms a 15-metre precipice at Kaledonia Falls.

It is hard to believe that within 2 km of Troodos village the rocks – ophiolite ('ophio' coming from the Greek word for 'snake') - are from below the ancient Tethys Ocean. They are rich in combinations of olivine and pyroxenes otherwise known as ultramafics and come from the upper mantle of the Earth's crust. One particular rock here is serpentinite that has a high content of asbestos. Asbestos was an important element in modern production of fire resistant clothes and building fabrics. At the settlement of Pano Amiantos large scale quarrying went on for most of the last century until the dangers of asbestos mining were realised. Today the abandoned quarries give a different perspective to the Troodos Mountains.

Troodos Mountains. Prominent feeder dyke of the ophiolite and, backgound, associated sheet flows. Photo: Lisa Tauxe

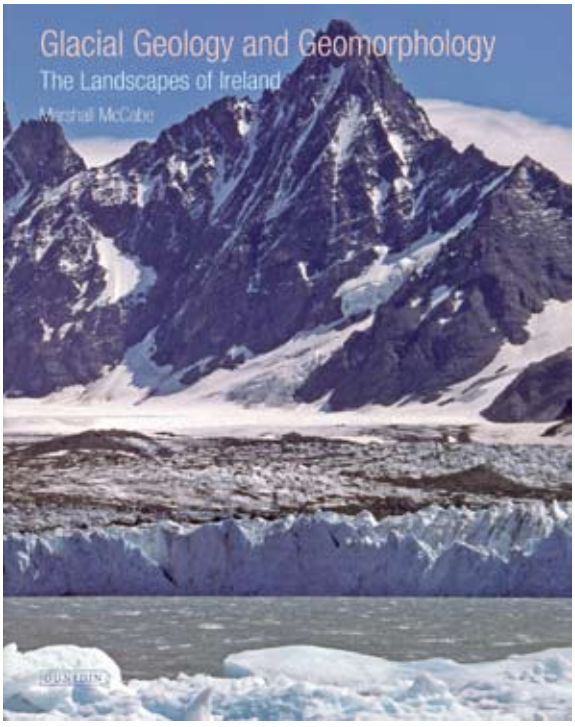
Picture for the botanists; flowers on chalk & limestone near Koura

Next time you think of a potential holiday in a warmer climate seriously think of combining it with a visit to the unique geological locality that is Cyprus.

Old asbestos mines near Pano Amiantos

Book Review

***Glacial Geology and Geomorphology**: The Landscapes of Ireland.* Marshall McCabe. 2008. Dunedin. 274pp. ISBN 978-1-903765-87-6 £85 €128



The breadth of knowledge exhibited in this volume suggests to me that it could only have been written by one person. Marshall McCabe's prodigious Irish geological research output in acclaimed journals over the last ten years is second to none. Marshall has, by detailed field description of sediment bodies, by the use of careful analyses of sedimentary units and their relationship to one another and by the timely use of C14 dating, transformed our understanding of Ireland's glacial history. In essence, were Professor McCabe a rock star this would be a double CD compilation of his greatest hits! In saying this I am not being flippant because an impressive array of research articles (from *J.Sed. Pet., QSR, JQS, Sedimentology, Sed. Geol.*, *Proc. Geol. Soc.* and *Nature* –to name a few) are contained here and these articles have been remixed, many in colour, to make them accessible in one place. In doing this McCabe has produced a marvellous volume that outlines his personal vision of Irish glaciation. The ability of the author in a text of this nature to explain his reasoning in more detail and to make local and regional correlations clear is a very valuable one and the publisher is to be congratulated.

The book covers the generalities of the Irish Quaternary record to set the scene but quickly moves on to the more detailed aspects of the glacial history of Ireland –principally that of the last cold stage –between 100,000 years ago and 10,000 years ago, from where we have the most information. Marshall details glacial events and the stratigraphy in a regional context, very much following the work he has carried out around Ireland. In the north he includes the stratigraphically critical sections at Aghnadarragh whilst in the northeast the superb sections from Dundalk Bay and north to Killard Point, which are a major element in ice sheet reconstructions, are given great coverage with many illustrations and detailed dating. The images and explanations expounded on drumlins, drumlinisation and rogen moraine are extremely useful to have so neatly reviewed. Marshall also details research in the Irish Sea and in the northwest and west from Donegal down to Killary Harbour. The sediments logs, models and maps are superb, as are the dated summaries from each region.

In addition to Marshall's own research areas and themes he has included important work from many relevant authors and has managed to place their work constructively within and alongside his own within the Irish Quaternary framework. Included here are sections detailing terrestrial deglaciation including the work of the late Francis Synge and of Michael Philcox in and around Glacial Lake Blessington, the work of Synge in the Glen of Aherlow and of Synge and McCabe along the Boyne. Other work incorporated into Marshall's scheme includes that on the Irish eskers where he has drawn on the research of Cathy Delaney, George Dardis and others and summarized the deglacial history of these wonderful landforms –again placing them in a constructive context.

If I had a criticism it is that a summary table or short summary chapter of events could have been effectively used to draw the various strands of evidence together and to make it clear to a general or less-informed reader the huge strides that are apparent in this work. Older paradigms are tabulated and explained –the new ones could also be summarised. In addition, I know this is not a textbook of glacial geomorphology, but some diagrams from existing texts that explain and summarise the range of landforms would have been useful (e.g. of morainic forms, drumlins, flutes and transverse ridges…), as would a single page description of the sedimentological abbreviations used. That said the book is not intended for beginners and will be of most use in advanced courses and to experienced earth scientists.

The book is long overdue. The overriding message for me was that we now have a far better understanding of the critical importance of the use of dating, the detailed sedimentological analyses and models and the importance of understanding ice sheet position, dynamics, ice sheet collapse, readvance and the role of Heinrich Events allied to the relationship of the ocean and of sea-level. McCabe puts all of these in a framework that we can now work with (and against) to further our scientific understanding of the events of the last cold stage. In summary no student of Quaternary science in Ireland will be able to complete a (good) undergraduate course without reference to this work nor will any scientist of repute attempt to carry out Quaternary research in Ireland without having taken the views expounded here into account.

Pete Coxon, *Department of Geography, Museum Building, Trinity College Dublin*

QUARRIES I HAVE MET

Marion Allen, stalwart of the Belfast Geologists' Society and Belfast Naturalists' Field Club, explains how she was attracted to geology.

Northern Ireland is one of the best natural Earth science classrooms in the world. However, since the disgraceful closure of the Geology Department at Queen's University Belfast there has been a serious question mark over the subject. Past events have shown there is a great public interest in geology and it can inspire the imagination of the young. With no third-level teaching available, other ways of maintaining and developing this interest must be actively explored.

North Quarry Entrance, Scrabo

As I thought *about* how I got involved in geology, I realised quarries had played a major part in my geological education. My father loved stones - if they were big enough to sit on and contemplate the universe, so much the better.

One of my earliest memories is playing on sultry summer afternoons amongst the flowers and butterflies on the flat floor of Scrabo South Quarry in County Down. It was here I learned to love sandstone.

Quarries helped get me started in geology. Rock textures, colours, crystals glittering in the sunlight and fossils. Only more important was the indulgence of a father who didn't throw away my precious stones.

Zeolites and calcite

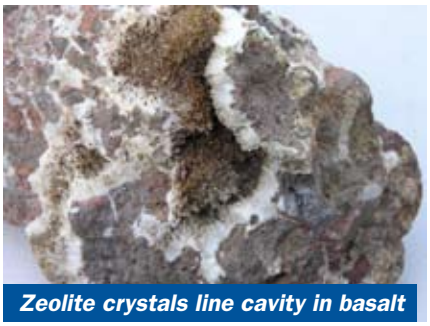
There is something comforting in wandering around a site holding a piece of rough-textured sandstone, especially when it comes in a rich array of reds, creams and golds. On special days I was walked to the great chasm of the entrance to North Quarry. To a child just big enough to hold her daddy's hand it was an awesome sight. *It still is today.* The stones I collected were placed on the car's parcel shelf. On one occasion, my treasures fell through a hole in the shelf *where they* rolled around the boot giving an excellent imitation of a cracked camshaft. *By our next excursion, I was given a bucket!*

Calcite

It was in the old quarries and along the coastal cliffs of County Antrim that I discovered basalt or, more precisely, the zeolite crystals that line the 'bubble cavities' in the basalt lava. The way they glittered and shone in the sunlight still takes my fancy. Now I know these crystals have intriguing names like analcite, natrolite and thompsonite.

A large policeman, who silently appeared from the undergrowth, interrupted a quiet picnic near Ely Lodge in County Fermanagh. "They are going to blast in the quarry, there might be a bit of a bang", he said. There followed a shattering explosion that covered us, and the tea, sandwiches and the buns, in a hail of limestone. *Egg and limestone sandwiches taste... well... interesting.* The air filled with the distinctive 'oily' smell of Ballyshannon limestone but it was much later I discovered the rock was full of fossils.

Another sunny afternoon memory is of the blinding whiteness of the Ulster White Limestone at Larrybane in County Antrim, and the discovery of a huge sheet of calcite glittering on the quarry wall.



Zeolite crystals line cavity in basalt

The inconvenience of having to earn a living interrupted my quarry exploring days but, during a conference, I visited a quarry near Reading in England whose dark muds held beautiful leaf fossils. My uncle set the fragile specimens in Plaster-of-Paris and put them in one of his wooden cigar boxes for the trip home. These are still my finest plant fossils.

I remember that the quarries at Eskra in County Tyrone had a rich variety of stones from many places including some carried by the ice from Scotland. One lorry driver was stunned to learn his load was so far travelled "*It came from where and how many years ago? Well boys-a-dear".*

The 2001 launch of Tim and Pam Fogg's excellent book "Beneath Our Feet", about the caves and limestone scenery of the North of Ireland, was finished by a quarry visit. So there I was, in my best frilly chiffon frock, dangly earrings, mascara, hardhat and boots in the middle of a working quarry deep in County *Fermanagh.* It was worth it as I found what I think is a great specimen of the large ancient sea snail *Bellerophon.*

Working through the red muds at Mills Quarry Caragnamuck, County Armagh, for fossils of the large brachiopod bivalve *Gigantoproductus* resulted in more than the fossils being iron-stained. On the way home, a sizable party stopped near Richhill for dinner. The hotel did not bat an eye at our dishevelled appearance and gave us an excellent meal. As we dried out the mud fell to the floor and we left a deep red detritus ring on the carpet around the table. We apologized profusely but the management assured us they had

Plant fossils in cigar box

a perfectly good vacuum cleaner!

The Northstone Croaghan Quarry in County Londonderry taught me about the nitty-gritty of turning olivine basalt into aggregate and that the massive 'automatic' Asphalt plant still needed two men and a large spanner! Their Carmean Chalk Quarry had some lovely fossils and in places the calcite was stained red by haematitic iron. Coloured glitter. Happiness.

However, there is more to quarries than geology. At the Carrowdore Tarmac quarry, where the quarry-master had gone to great lengths to get TV cameras set up, I watched nesting peregrines on TV from a comfortable chair. In a quarry in County Armagh, we found three kinds of the uncommon Broomrape plant (Orobanche spp.)

Red flint

To me quarries have been my geological classrooms. They show the vast scale of geology and can contain fascinating specimens and glimpses into the past. All the quarry men I have met have been helpful. Most have been surprised, and bemused, that we were interested in their quarry.

Quarries continue to intrigue me, especially because the rocks are freshly exposed. I am pleased some companies are now positively supporting school educational projects and visits (ESI Magazine, Issue 2, page 10.). *Hopefully the idea will spread.*

Letters to the Editor

Inch Conglomerate

Dear Editor, I refer to a recent article in Earth Science Issue 2 Autumn 2007 " Give an Inch, lose a mile" by Bettie Higgs.

The site in question is not listed in the current Kerry County Council Heritage Plan 2003-2007 or the Current Kerry County Development Plan 2003-2009 as stated within the article. The factual situation is thus:

The site is listed in appendix 5 in the recently adopted (*24th September 2007*) 2008-12 Heritage and Biodiversity Plan, which will become operational on January 1st 2008.

The appendix of significant geological sites is noted in aim 2.2.2 of the Heritage and Biodiversity Plan 2008-12 *"Examine the inventory of sites of geological importance (appendix v) with a view to having them designated within future County Development and Local Area Plans."*

The list is further mentioned in aim 3.1.8 of the Heritage and Biodiversity Plan 2008-12

"Seek to protect from inappropriate development the scheduled list of geological sites in appendix 5"

Inch is mentioned in the current County Development plan 2003-2009 in appendix 1F (Geological and Geomorphological sites) as being of importance due to the presence of a Tombolo; no further information is given.

I have passed this article onto the relevant engineer who dealt with the issue on the ground who may revert to you with further clarification.

I request that the factual errors be passed on to the author and noted in the next edition of Earth Science Ireland. *Mise Le Meas*, ***Una Cosgrave Hanley, Heritage Officer***

[The article is worth reading if you haven't seen it. Whatever the rights and wrongs an important site was lost but there were said to be developments about to take place to redress the situation a little. As yet we have nothing further to report. ***Editor]***

Slightly alarming

Dear Editor, I was slightly alarmed to hear my 87 year old (Belfast born) mother chortling away to herself in my sitting room. No, it wasn't the mighty strange rocks we've got hereabouts that were going to her head –no, she'd picked up my Autumn 2007 issue of Earth Science Ireland and was nearly helpless with laughter at David Kirk's article *Fancy a Little Petting – Rock On.*

…We'd both like to commend the whole team at ES2k for presenting geology in such an easily digestible and enjoyable format…. I am three quarters way through an Open University geosciences degree course, which I find a lot of fun and ESI is one of several publications I read for broadening my learning. I have already visited the Causeway Coast, Mourne Mountains and the Burren, but as a tourist rather than a student.

The Open University Geological Society runs very good field trips in Ireland and there are tempting events advertised in ESI. I hope to sample some and am determined that my next visits will have more of an educational bias, not that my delightful days at the Guinness Storehouse and the Bushmills Distillery did not teach me a thing or two! ***Trevor Lockwood, Helston, Cornwall***

Two letters from knowledgeable friends whose views we greatly respect

I must congratulate your contributors to ESI…it really is a quality publication, attractively presented and must really make an impression on would-be geologists. ***Eric Robinson, Watchet, Somerset***

Thank you for the magazine. Absolutely terrific. It shows that geology is not dead in the UK *[sic]*. ***John Dewey, Senior Common Room, UC, Oxford***

[I think John perhaps means " UK and Ireland'. ***Editor****]*

COMPETITION

1. **Can you tell us what the eyes belonging to those feet are looking at?**
2. **Do you recognise the mountain and can you suggest the main rock type to be seen there?**


1


2

Answers by email to: rbazley@btinternet.com **or** post to: Editor, ESIreland, 19 Inishanier, Whiterock, Killinchy, Co Down BT23 6SU

Winner will be drawn from all the correct answers. Prize is a book – '*Earth – The Dynamic Planet*' and the pleasure of being proclaimed the winner in the next issue.

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